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Some effects of rural subdivisions on wildlife and wildlife habitat around Lolo Montana

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SOME EFFECTS OF RURAL SUBDIVISIONS ON WILDLIFE AND WILDLIFE HABITAT AROUND LOLO, MONTANA

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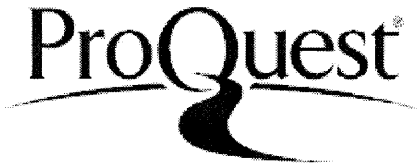

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The effects of subdivisions on wildlife and wildlife habitat were studied for two years beginning in July 1973. The 10,189 acre study area was located in the Bitterroot Valley area of Western Montana. Land use within the study area was predominantly agricultural but residential land development accelerated between 1957 and 1973.

Ownership maps for pre-subdivision and current periods, and a land use map for the pre-subdivision period were prepared. Aerial photographs were used to delineate cover types and to measure the acreages of each cover type destroyed or altered by subdivision. Observations of wildlife, wildlife habitat, domestic dogs, and people were made along six routes located adjacent to residential areas. Extensive interviews were conducted with local residents.

Subdivisions often lessened the interspersion between cover types, broke the continuity of dense cover areas utilized as travel corridors and escape routes, and reduced the total acreage of cover areas utilized as sanctuaries. The most heavily used cover areas were those separated from subdivisions by physical barriers. The density of homesites largely determined the amounts of food, water, and cover remaining within residential developments.

Medium-sized carnivores, and many avian species displayed a greater ability to adapt to the habitat changes caused by residential land development than other species. Elk (Cervus elaphus) usage of winter range areas adjacent to subdivisions occurred mostly during periods of winter stress. Elk, white-tailed deer (Odocoileus virginianus), and coyotes (Canis latrans) utilized the strips of forested areas around subdivisions as travel corridors.

Incidences of dog harassment of wildlife species have increased with subdivision development.

Nine management suggestions were made, along with a proposal for future studies.

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CHAPTER I

INTRODUCTION

Thousands of acres of privately-owned land in Montana are presently being subdivided. With such changes in parcel size and land ownership, subsequent changes in land use frequently follow. Tract homes, ranchettes, trailer courts, shopping centers, highways and recreational resorts are increasingly found where human influence was previously either custodial or one of agricultural use (including forest management). When these land use changes occur, the quality of such land for most animal species living there also changes. As a result, both species diversity and the abundances of individual species are often affected.

Some wildlife habitats are destroyed outright when land is subdeveloped. For example, homes, paved roads and ski lodges completely cover the land surface. Other habitats are physically altered by such activities as the removal of trees and brush, the drainage of wetlands, the riprapping of stream banks, and the construction of access roads. These alterations tend to change the interspersion and size of cover types, and alter the stages of vegetative succession.

In addition to the removal or alteration of the physical aspects of wildlife habitat, subdevelopments influence the quality of wildlife habitats in adjacent, non-developed areas. These influences are related to the increased numbers of people living in an area and include such factors as free-roaming dogs, changes in hunting pressure, and increased recreational usage of these lands.

The lands most susceptible to residential subdevelopment in Western Montana are those including a creek or river, the associated valley, and the adjacent hillsides. Such areas are usually relatively low in altitude and are likely to have a wide diversity of vegetation types. This diversity favors large, heterogeneous populations of birds and mammals.

The area chosen to study the effects of residential subdevelopment on wildlife and wildlife habitats encompasses the vicinity of Lolo, Montana. Lolo is an unincorporated community in the northern half of the Bitterroot valley (Figure 2). The land surrounding Lolo has undergone considerable subdivision activity since 1957 (Figure 1). These subdivisions have been developed primarily for year-round residential usage.

Magnitude of Subdivision Development in Montana

An increase in subdivision activity occurred in Montana during the 1960s and early 1970s (Tomlinson 1972, Brandes 1974, Environmental Information Center 1975). Acknowledging the difficulty in assessing the degree of such activity, the Montana Environmental Quality Council estimated that 510,000 acres lying outside cities and towns may now be subdivided into parcels of less than 40 acres (Brandes 1974).

The Montana Environmental Quality Council's estimate of 510,000 subdivided acres means that roughly one percent of the private land in Montana was divided into parcels smaller than 40 acres in 1973. The Environmental Quality Council predicted that eight percent of the private land in Montana will be subdivided into parcels of 40 acres or less by 1985 if the rate of subdivision experienced during the 1972-1973 time period continues (Brandes 1974). Appendix A gives the acres of

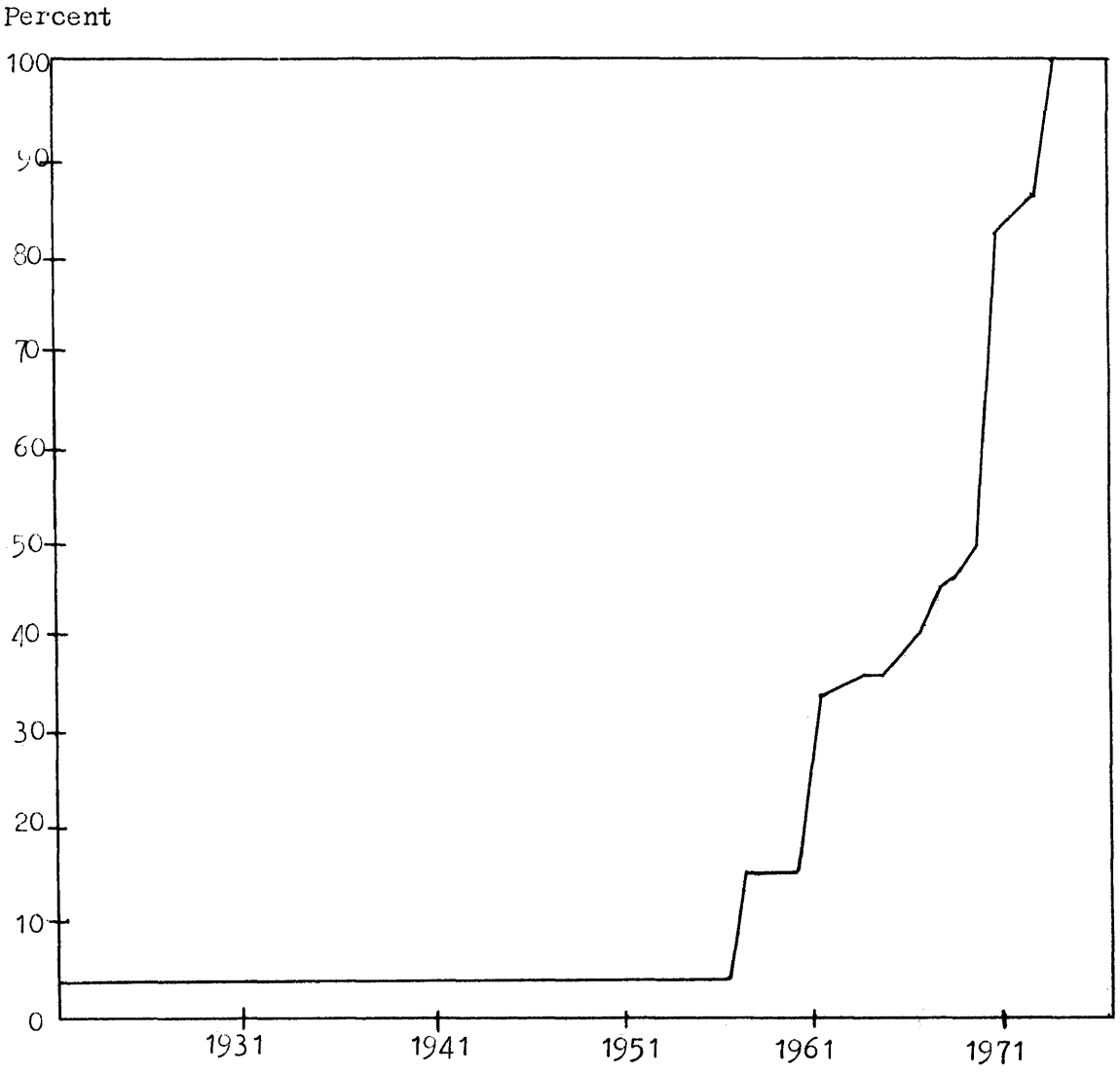

Figure 1. Rate of Lolo subdivision expressed as a percentage of the 1971 subdivision acreage.

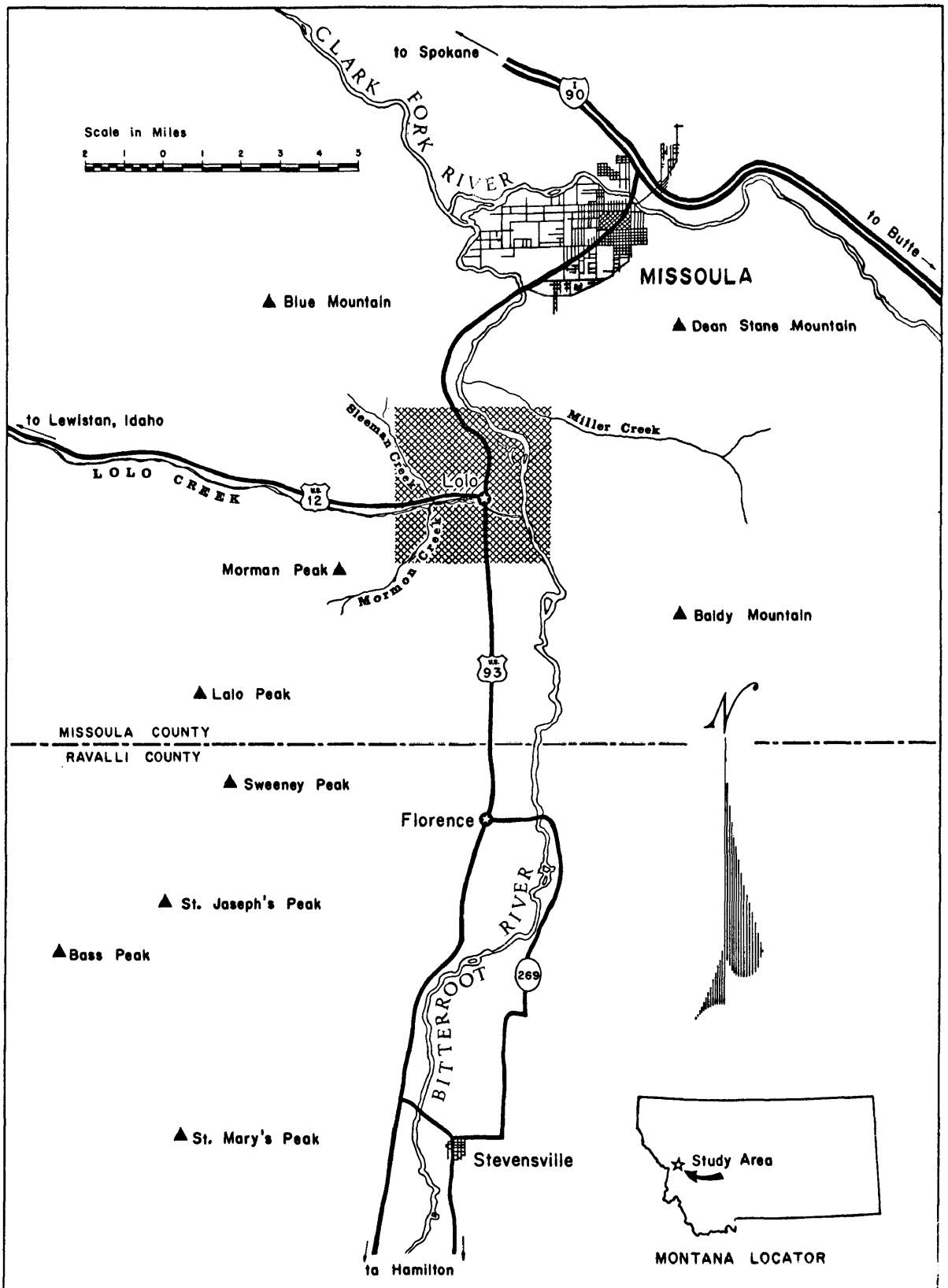

Figure 2: Location of the Study Area

subdivision by county as calculated by the Montana Department of Revenue (1974) and by the Environmental Information Center (1975).

The data on the magnitude of subdivision development are a measure of pending land use change. Often land that is sold retains its "pre-subdivision" vegetative cover long after it is sold, either because the owner does not build immediately or because such land is being held for speculative purposes.

Agricultural land provides habitat for many species of wildlife. It is also particularly attractive to the subdeveloper as residential building sites. Much agricultural acreage is level and open, thus requiring low development costs relative to hilly or forested land.

The spread of subdivisions in Montana has resulted in the loss of thousands of acres of farmland, as well as forested acres and other cover types. Table 1 shows that as agricultural land decreased between 1963 and 1973, the number of acres of "suburban tract" increased.

The Montana Environmental Quality Council (E.Q.C.) points out that 16 percent (264,521 acres) of the approximately 1.6 million acre decrease in agricultural land between 1963 and 1973 (Table 1) was removed during the 1972-1973 farm year alone (Brandes 1974). If this conversion continues the E.Q.C. calculates that there would be 4.5 million fewer acres in Montana agricultural land in 1990 than in 1973 (Brandes 1974). In 1972-1973, 24 percent of the decrease in agricultural land was represented by an increase in suburban tract acres (Table 1).

Lolo is located in Missoula County, a county that in recent years has shown an accelerating rate of change in land use from agricultural to residential (Missoula County U.S.D.A. Committee for Rural Development 1972).

Table 1. Acreage in agricultural land and suburban tracts in Montana for 1963, 1972, and 1973[1]

Year	Acreage in Agricultural Land	Acreage in Suburban Tract[2]
1963	53,416,723	36,501
1972	52,037,832	225,886
1973	51,773,311	289,876
	Decrease	Increase
1963-1973	1,643,412	253,375
1972-1973	264,521	63,990

The Environmental Information Center (1975) reported that in the summer of 1974, Missoula County contained approximately 40,816 acres outside of cities and towns that were divided into parcels 40 acres or less in size. Such subdivision is reflected in the fact that Missoula County had 509 farms in 1959, 431 farms in 1964 and 327 farms in 1970 (Missoula County U.S.D.A. Committee for Rural Development 1972). Some of this decrease in farm numbers can be attributed to farm consolidation. The average farm size for Missoula County was 618 acres in 1954 and 1,038 acres in 1969 (Missoula County Committee for Rural Development undated).

Justification for Study

As subdivision pressures increase in Montana, their effects on wildlife become more important and the need for data concerning such

[1]Table 1 was taken directly from "The Montana Land Use Policy Study" (Brandes 1974). The data used in constructing Table 1 was provided by the Montana State Board of Equalization (1964 and 1972) and the Montana Department of Revenue (1974).

[2]For a discussion of the meaning of "Suburban Tract" see Appendix A.

effects grows. The condition of the wildlife resource in Montana, especially that of game animals, is important to the leisure pleasure of Montana's citizens as well as to Montana's economic health. Residents and tourists spend millions of dollars annually on such animal-related activities as visits to National Parks, hunting, and wildlife photography. Travel, with an estimated value of $242 million in 1973, is the fourth most important industry in the state (Montana Department of Agriculture 1974). Travel is outranked only by agriculture ($2,239 million), mining and petroleum ($490 million), and manufacturing ($468 million).[3]

Wildlife has been an important part of Montana's heritage and remains an important part of the quality of life enjoyed by her citizens. The opportunity to share wildlife habitat with varied and often abundant species is an integral part of the reason why many people chose to live in Montana.

All species of wild animals are products of the land and their destiny, therefore, depends on how man chooses to utilize the land (Mussehl and Howell 1971). Given the importance of wildlife to the Montana economy and way of life, there is a need to study the impact of land development on wildlife to determine ways to minimize impacts that are detrimental to this resource.

In 1971 the Montana Environmental Policy Act (M.E.P.A.) set forth this need in the form of legislation (Choate and Wertz 1947d). The Act

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[3]Mussehl and Howell (1971) stated that outdoor recreation (excluding transportation) was the fourth most important Montana industry behind the same three industrial groups. Mussehl and Howell received their data from the Montana Department of Planning and Economic Development.

requires that all state agencies assess the environmental impact of proposed agency actions that significantly effect the quality of the human environment.

Subsequent to the passage of the M.E.P.A., the Montana Subdivision and Platting Act (Choate and Wertz 1947b) was passed in 1973. Section 11-3851 of this act requires that wildlife use in the area of any proposed subdivision be assessed before the subdivision plat is approved. In reviewing numerous impact statements written in accordance with Section 11-3851, I found that the information concerning wildlife and wildlife habitats contained therein is usually lacking in detail. Such cursory information is partially due to the time constraints placed on the collection of such data. There is a need, then, for a method designed to quickly and thoroughly assess the effects of proposed subdivisions on wildlife and wildlife habitat.

"Habitat" may be briefly defined as that particular group of external factors or conditions which a species requires for its survival and reproduction. These factors encompass both the biotic and the abiotic components in the animal's environment. Some of the best understood habitat components are soil, climate, vegetation structure, cover, and food. Habitat is dynamic. Water availability changes with seasons; food availability changes with vegetative succession and seasons; climatic factors change with season, altitude and aspect. Man occupies the habitat of many species and in doing so often enhances or lowers the quality of such habitat. Since habitat requirements vary from species to species,

the term "habitat" in this study will often be prefaced with the name of a particular species; for example, elk (Cervus elaphus) habitat or mallard (Anas platyrhnchos) habitat.

Subdivisions Defined

Historically, subdivisions have been defined and regulated under two areas of the Montana codes: (1) platting requirements for cities and towns and (2) public sanitation. Statutory requirements involving subdivisions and the economic implications of land development are not part of this study. There exists, however, much confusion between what appears to be a rural residential area and what is indeed a platted subdivision that is subject to the regulations in the Montana codes.

Montana has had statutes requiring that new housing tracts be platted and then filed with the county clerk and the recorder's office since 1895. Sections 11-601 through 11-616 of the Montana Codes (Choate and Wertz 1947a) specify that housing tracts be carefully designed and surveyed and that a part of such tracts be dedicated to public use.[4] Section 11-614 states that:

> Any person who desires to subdivide and sell or transfer any tract of land in small tracts, such as orchard tracts, vineyard tracts, or community tracts, containing less than the U. S. legal subdivisions of 10 acres, or who shall subdivide and/or sell or transfer any irregularly shaped tracts of land, the acreage of which cannot be determined without a survey must cause the same to be surveyed, platted, certified and filed in the office of the county clerk and recorder in which said land lies . . . before any part or portion of the same is sold or transferred.

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[4]Sections 11-601 through 11-616 were repealed by the 1973 Montana legislature.

According to this definition, trailer courts and other rental property were not considered subdivisions. Also, a property owner was entitled to sell or lease at least one parcel smaller than 10 acres without such a transaction being considered a subdivision as defined in the statutes.

Sections 69-5001 through 69-5005 of the Montana Codes (Choate and Wertz 1947c) were added in 1967 to ensure that plans for water and sewage disposal facilities in all subdivisions are approved by the Department of Health.[5]

These early subdivision laws were often ignored or circumvented. One of the most common ways for property divisions to go unrecorded was through sales made on a contract-for-deed basis. In Ravalli County, which encompasses much of the Bitterroot Valley south of Lolo, nearly two-thirds of all the subdivision transactions recorded occurred on a contract-for-deed basis, three-fourths of which went unrecorded (Montana Department of Intergovernmental Relations 1972).

Other methods used in circumventing the existing laws were to divide one's property with a metes and bounds survey (Tomlinson 1972), or to sell lots that do not fit the definition of subdivision as defined in the Montana Codes. The Montana Department of Intergovernmental Relations (1972) reported that in past years, local officials often did not exercise the authority given to them for regulating subdivisions.

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[5]This law requires the removal of sanitary restrictions before any plat map for a "subdivision" may be accepted by the clerk and recorder's office. The removal of sanitary restrictions also applies to leased or rental property. The name of the Montana Department of Health was changed to the Montana Department of Health and Environmental Sciences in 1972.

The Lolo study area contained 24 platted subdivisions when this study began in July, 1973. All were platted in accordance with Sections 11-601 through 11-616 of the Montana Codes (Choate and Wertz 1947a). Other property splits within the study area escape the label of subdivision either because they did not meet the legal definition of subdivision or because the existing subdivision laws were circumvented.

The 1973 Montana legislature passed two comprehensive laws designed to strengthen the regulation of subdivisions. One was the "Montana Subdivision and Platting Act" (Choate and Wertz 1947b). The other was House Bill 465, a law giving greater power to the State Department of Health and Environmental Sciences to enforce subdivision sanitation requirements (Choate and Wertz 1947d).[6]

The Montana Subdivision and Platting Act (Choate and Wertz 1947b) included detailed provisions for subdivision recording and platting, a requirement that local governing bodies must adopt subdivision regulations, the submission of environmental assessments for proposed plats, and formal review of subdivision plats by local and state agencies and by the public. This act also redefined "subdivision" in order to subject a greater number of rural property splits to the new platting and sanitation requirements. Section 11-3861 of the Montana Subdivision and Platting Act defines "subdivision" as follows:

> Subdivision means the division of land or land so divided into two or more parcels, whether contiguous or not, any of which is ten acres or less, exclusive of public roadways, in size, without regard to the method of description thereof, in order that the title or possession of the parcels or any interest therein

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[6] House Bill 465 amended Sections 69-5001 through 69-5005 of the Montana Codes (Choate and Wertz 1947d).

> may be sold, rented, leased, or otherwise conveyed either immediately or in the future, and shall include any resubdivision of land; and shall further include any condominium or areas providing multiple space for camping trailers, house trailers or mobile homes; provided further that a division of land is a subdivision when the division creates a second or any subsequent parcel for the purpose of sale, rent, lease, or other conveyance from a tract of land held in single or undivided ownership on July 1, 1973, where any of the parcels segregated from the original tract is ten acres or less, exclusive of public roadways in size, without regard to the method of description thereof . . . .

In 1974, the Montana Subdivision and Platting Act was amended by the state legislature. Among the amendments was a change in the definition of "subdivision" to include the division of land into one or more parcels of less than 20 acres (Choate and Werta 1947b as amended in 1974).

Also included among the 1974 amendments was a requirement that all divisions of land for sale other than subdivisions which are smaller than 1/32 section (usually 20 acres) must be surveyed by or under the supervision of a registered land surveyor. The surveyor must then file a certificate of survey with the clerk and recorder's office. This amendment seeks to assure that after June 30, 1974, virtually all subdivision of land must be recorded, whether such a split is part of a platted subdivision or not.

There are several exceptions to the definition of "subdivision" found in the "Montana Subdivision and Platting Act" as amended in 1974. Such exceptions include gifts or sales to the landowner's immediate family, occasional sales, divisions made for the purpose of relocating a common boundary between adjoining parties, and division where the parties involved and the local government enter a covenant providing that such land will remain in agricultural use.

If all the property splits within the Lolo area were defined according to the definition of "subdivision" as amended in 1974, this area would contain many more acres of legally platted subdivision. Since wildlife cannot differentiate between a "subdivision" as defined in the Montana Codes and a group of homes, both were accorded field observation.

Objectives of the Study

1. To determine the acreage of wildlife habitat lost in a clearly defined area that has both existing and proposed residential subdivisions within its boundaries,

2. To determine the alteration in the quality of the wildlife habitat when homes were built within such habitat,

3. To determine the changes in wildlife use of habitats adjacent to residential subdivisions as a result of the increased human and human-related activities in these areas, and

4. To suggest methods for lessening the detrimental impacts of rural subdivisions on existing wildlife and wildlife habitats.

CHAPTER II

REVIEW OF THE LITERATURE

Many authorities have commented on the effects of rural subdivisions on wildlife and their habitats (Stearns 1967, Gerstung 1970, California State Resources Agency 1971, Larson 1971 and 1972, Gill and Bonnet 1973, Noyes and Progulske 1973, Jezeski et al. 1973). Only in a few cases, however, have intensive studies been conducted on the relationship between rural subdivisions and wildlife. One such study (Figley and Vanduff 1973) was an analysis of the nesting and brood success of mallards in a New Jersey lagoon development. Another (Geis 1973) was an analysis of the bird species diversity and bird abundance before, during and after the construction of the town of Columbia, Maryland.

Figley and Vanduff (1973) found that although mallards adapted very well to nesting in suburban environments, brood survival was poor. In comparing lagoon nesting mallards to mallards nesting in the adjacent marshes, the marsh-nesting birds were found to have smaller clutches and fewer young at hatching but their broods had a higher survival rate. They concluded that lagoon-reared broods had insufficient escape cover to protect them from herring gulls (Laurus argentatus) and laughing gulls (L. adtricilla) by day, and by domestic cats at night. Other reasons cited for the poor clutch survival rate included: poor supplies of invertebrate food sources in the lagoon development, man-made hazards such as storm sewers, harassment of broods by unpaired drakes, and the capturing

and scattering of young broods by people. Night lighting was also considered a possible predation factor.

During the course of Geis' (1973) study, the area of Columbia, Maryland, changed from a sparsely populated farmland to a community of over 27,000. Farmland species such as the bobwhite and mourning dove showed a dramatic decline. Such field-inhabiting species as the eastern meadowlark (Sturnella magna), redwinged blackbird (Agelaius phoeniceus) and grasshopper sparrow (Ammodramus savannarum) also declined, as did woods and woodland edge species such as the wood thrush (Hylocichla mustelina) and indigo bunting (Passerina cyanea). Starlings (Sturnus vulgaris) and house sparrows (Passer domesticus), on the other hand, increased dramatically. Both were virtually absent in the area before development occurred. Increases were also noted in some desirable species such as mockingbirds (Momos polyglottos), chipping sparrows (Spizella passerina) and song sparrows (Melospiza melodica); birds that prefer habitats associated with dwellings.

Urbanization tends to have a greater impact on larger animals, especially those which are predators and those which tend to herd together. Gill and Bonnet (1973) and Caldwell (1973) pointed out that free-ranging species, for example the pronghorned antelope (Antilocapra americana), require vast unbroken tracts of land and would probably be severely affected by subdivisions that break up their habitat. Large predators (avian and terrestrial) decline in numbers as homes spread into the countryside, while other predators such as housecats, dogs, rats and children increase (Stearns 1967, Gill and Bonnet 1973).

Gill and Bonnet (1973) felt that medium-sized carnivores such as the fox or coyote are often capable of adapting to the changes in their habitat caused by rural or suburban subdivision. Larger carnivores such as wolves (Canis lupus) or cougar (Felis concolor), on the other hand, have their best chance of surviving near housing developments when areas of sharp relief create an abrupt juxtaposition between the built and unbuilt areas (Gill and Bonnet 1973).

In his study of the coyote and man in Los Angeles (in Gill and Bonnet 1973), Gill found that an important reason for the close proximity of the coyote to an urban population was the sharp transition between the built-up parts of Los Angeles and the vast wild areas that lie on the city's periphery. In addition, Gill notes that the coyote populations survived best in those intracity undeveloped areas that were linked to the peripheral wildlands by undeveloped corridors.

Others have also commented on the varying degrees of adaptation exhibited by different wildlife species. Wild turkeys (Melagris gallopavo) in Texas, for example, are among the first species to disappear when an area is subdivided (Moore, Jan. 15, 1974, letter). However, black bear and beaver in New England are increasing in second growth forest areas, many acres of which are currently being subdivided into large lots and cluster developments (Larson 1972). In the lagoon developments studied by Figley and Vanduff (1973), mallards and white Pekin ducks were the only waterfowl nesting within the development while black ducks (Anas rupripes), mallards, gadwalls (A. streptera), blue-winged teal (A. discors) and white Pekin ducks all nested in the nearby marshes.

When man alters the landscape, there is eventually a point beyond which non-native species have an ecological advantage over the native species (Larson 1971, 1972). Howard (1973) stated that most species are unable to adapt to the radically different habitats constructed by man; those that do adapt may exhibit a high degree of ecobehavioral and genetic plasticity. The displacement of native birds by radical changes in the environment may be lessened by appropriate landscape plantings (Gill and Bonnet 1973, Howard 1973).

I sent letters to the Fish and Game Departments of California, Idaho, New York, Oregon, Texas, Washington, and Wisconsin. Each agency was asked if they knew of research in their state concerning the problems of subdivisions and wildlife. Although all seven states acknowledged that they had lost a significant amount of wildlife habitat to subdivisions, only California indicated that they had already collected data concerning the problem (California Resources Agency 1971). In a statement before the California Legislature, the California Fish and Game Department (Cloyd, Feb. 20, 1970, statement) indicated that the following effects were typical of the problems that subdivisions were causing various wildlife species in the state: the destruction of a 750-acre marsh historically used by geese and other waterfowl, the filling of potholes used by waterfowl, and the fencing and subsequent development of several hundred acres of antelope and sage grouse (Centrocercus urophasianus) habitat. In addition, two subdivisions (totaling about 6,600 acres) have recently been built within an important mule deer (Odocoileus hemionus) winter range on the east slope of the Sierra-Nevada Mountains. Aside from the loss

habitat to road and home development, these two subdivisions have upset the migration patterns of the deer herd.

Since 1964, open land in California's Nevada County has been converted into lots and small parcels at the estimated rate of 5,000 to 10,000 acres annually (Gerstung 1970). Much of this activity has occurred in the woodland-chaparral and pine-chaparral vegetation types both of which are important habitat for the California quail (Lophortx californicus), cottontail rabbit (Sylvilagus spp.), grey squirrels (Sciurus griseus) and mule deer (Gerstung 1970). Rabbit (Allen 1962, Gerstung 1970) and quail (Gerstung 1970) populations are very dependent on well dispersed ground cover and the elimination of such cover leads to reductions in population size. Also, the woodland-chaparral vegetation type often is a critical factor in determining deer survival during severe winters and the cutting of hardwoods in this type leads to rapid declines in grey squirrel populations (Gerstung 1970).

The infringement of subdivisions onto winter range is a common problem in the mountainous states of the West. In Idaho, for example, subdivisions near the town of Ketchum have caused displacement of entire wintering herds of deer and elk (Oldenburg, Nov. 26, 1973, letter).

In Montana's Flathead County, nearly one-third of all big game winter range was reported to be in small private ownership (Flathead County Areawide Planning Organization 1973). Nine thousand acres (approximately 6.7 percent of the ownership) have already been subdivided into residential plots.

A review was conducted of the environmental impact statements written for many proposed subdivisions in Montana. In comments attached

to a number of these statements (Montana Department of Health and Environmental Sciences 1972a, b, 1973a-l, 1974), the Montana Fish and Game Department indicated that numerous species of game animals would be adversely affected if such subdivisions were approved and housing developments subsequently replaced the native cover.[7]

The loss or impairment of winter range areas for deer and elk was the most common adverse effect mentioned by the department. In the proposed Beaver Creek South Subdivision (Montana Department of Health and Environmental Sciences 1974), for example, the immediate area served as a winter range for approximately ten elk as well as an unknown number of deer. It was felt that the carrying capacity of the area for deer, elk, and other species would be permanently reduced once construction began.

In Fish and Game comments attached to the impact statement for the Eagle Creek and Smith Lake Vista Subdivisions in Flathead County (Montana Department of Health and Environmental Sciences 1973b and e) it was noted that such subdivisions alone would not prove catastrophic to the local wildlife resources; however, the combined effects of these and the other subdivisions being developed in the same general area would have a significant negative impact.

A study of the impacts caused by Montana's Big Sky Resort (Jezeski et al. 1973) indicated that land development in the 159 square mile study area had already reduced big game winter range habitat by 11 percent prior to the initiation of the study in 1970. If land development radiates from

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[7]The species mentioned in one or more of these statements included elk, moose, big horned sheep (Ovis canadensis) white-tailed deer, ruffed grouse, spruce grouse (Canachites canadensis franklin), Canada geese, and various species of ducks.

the existing commercial site, it was felt that two major elk wintering areas would be infringed upon and a net drop in elk populations would result.

The density of houses on subdivided land is another important consideration in the relationship between subdivisions and wildlife. In California's Nevada County, Gerstung (1970) noted that subdivisions with lots smaller than one acre or without significant open space reservations were particularly deficient in wildlife habitat. The Montana Fish and Game Department (Montana Department of Health and Environmental Sciences 1973d) suggested increasing the size of each lot in some subdivisions in order to lessen the reduction in vegetation which support species such as the white-tailed deer and ruffed grouse.

Geis (1973) noted that as the density of land development increased the variety of bird species declined, yet the absolute number of birds increased. The increase was attributed to a rapid rise in the number of starlings and house sparrows as the town grew. Geis, however, found no evidence that high starling and house sparrow populations depressed the breeding populations of other species.

The habitat for some species is enhanced when land is initially disturbed by subdevelopment. Gerstung (1970) noted that in low density subdivisions, mule deer may benefit from activities that open up dense conifer stands or old brush fields. Such benefits are nullified, however, as building density increases and lawns replace the native vegetation. Similarly, Caslick (1972) found that land released from agricultural use provided wildlife habitat for a wide variety of species until such time as this land was put to more intensive uses. Land that is sold to the

subdivider often retains its pre-subdivision cover long after it is sold because such land is being held for speculative purposes.

Safety considerations posed by subdivisions often impair the hunting opportunities in areas near the development. Bans or severe restrictions on hunting can lead to problems in the regulation of animal numbers in these areas (Gerstung 1970, Larson 1972).

The Beaver Creek Subdivision in Montana, for example, is located adjacent to the Gallatin Game Range. The Montana Fish and Game Department (Montana Department of Health and Environmental Sciences 1974) pointed out that in the future people will no doubt attempt to change the hunting use in a large part of this area due to the safety hazard the hunters pose to homes, passing autos and schools. Trapping and transplanting the excess animals in such a situation is a possible solution; however, Picton (1972) estimated that control of animal numbers through hunting is at least seventeen times more efficient in financial terms than control through trapping and transplanting.

In many rural subdivisions, a small percent of the dogs run free for at least part of each day. Many feel that such dogs can cause serious damage to deer and other wildlife species; however, few scientific studies have been undertaken to document the extent of such damage (Corbett et al. 1971, Perry et al. 1970, Denney 1974). The small amount of research that has been conducted has occurred in the northeastern and southeastern states and the results presented do not settle the controversy (Denney 1974).

In a study in North Carolina, for example, Corbett et al. (1970) found that dogs killed some deer in mountainous terrain but it was not conclusive that such dogs were killing enough of the population to limit

its size. Furthermore, it was noted that most of the deer killed by dogs were already predispositioned to mortality by old age, injury or severe parasite infestations.

Although the wildlife-dog problem in the western states has not been specifically studied, there is a great potential for dogs to prey on big game species that are concentrated on their winter ranges (Denney 1974). Reports of such predation are becoming more common in mountain subdivision areas as well as skiing and other recreation sites (Denney 1974). For example, dogs have been seen harassing bighorn sheep on a winter range along Montana's Gallatin River near the developing resort area of Big Sky (Pozewitz, as quoted by Moore 1973). Dogs have also been reported killing white-tailed deer on the ice at Montana's Whitefish Lake (Kendall, Mar. 28, 1974, discussion).

Richard Denney, who conducted a review of the dog-wildlife problem for the American Humane Association (Denney 1974), reported evidence of dogs killing deer (over 20,000 annually in 32 states), elk (in Colorado), bighorn sheep, waterfowl, wild turkey, quail, pheasant, rabbits, and songbirds. Dogs were reported to kill up to 75 percent of the annual goose production in the Washoe Lake area of Nevada. The destruction of ground nests by dogs was also reported in Denney's study.

The Bureau of Sport Fisheries and Wildlife estimated that free roaming dogs from a 72.5 acre subdivision located a quarter mile from a small lake could seriously reduce successful ground nesting of ducks and other birds for at least one mile in any direction (Montana Department of Health and Environmental Sciences 1973e). Gerstung (1970) felt that dogs preyed especially on young deer.

Denney (1974) cited studies by Doucet (1973) and George (1973) to indicate that domestic cats in rural areas can also be serious predators of wild animals. Doucet described the apparent predation of a snowshoe hare (Lepus americanus) by a domestic cat and the four-year study by George indicated that the removal of rodents and other prey by cats might be a contributing cause in the increasing decline of hawk populations.

In summarizing the effects of uncontrolled pets on wildlife, Denney (1974) concluded:

> It is apparent, though not well documented, that the impact of dogs (and cats) can be detrimental to the wildlife under specific circumstances, depending on the wildlife species involved, the relative population of predator and prey species, other mortality factors, habitat factors (quality, physiography, geographic location), and land use (the incursion of developments into wildlife habitats).

CHAPTER III

THE STUDY AREA

Location

The study area is composed of 16 adjacent sections of land surrounding the confluence of Lolo Creek and the Bitterroot River.[8] This area is part of the "Broad Valley Rockies" environmental region (Crowley 1972) and is situated west of the continental divide. Included within the study area are a portion of the extreme northern Bitterroot Valley, portions of the lower Lolo Creek and Sleeman Creek Valleys, and the entire Mormon Creek Valley (Figure 2). Also included is a small corner of the lower Miller Creek Valley. Topographically, the study area consists of valley bottoms and the lower slopes of the adjacent mountain ranges.

In the Lolo vicinity, the Sapphire Range rises sharply to the east of the Bitterroot River. To the west of the river, the valley is wider and is bounded by the Grave Creek Range to the north of Lolo Creek, and by the Bitterroot Range to the south of Lolo Creek. Elevations within the study area range from 3100 feet at the Bitterroot River to 4800 feet in the northwestern part of the study area.

The emergence of Lolo Creek into the Bitterroot Valley from the west is the site of a considerable narrowing in the valley's width. To

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[8] This area may be defined as Section 1 through 4, Township 11 North, Range 20 West, and Sections 21 through 28 and 33 through 36, Township 12 North, Range 20 West, Bitterroot Guide Meridian. Since no two sections within the study area have the same number, all future references to a particular section or sections will exclude the township and range designations.

the north of Lolo Creek, the valley extends another five miles before joining the Missoula Valley. Here the Bitterroot Valley is quite narrow, varying in width from approximately one-quarter mile to one and one-half miles.

The study area consists entirely of county, state, private, and corporately owned land. Extensive national forest lands lie outside the study area at higher altitudes.

Geology

McMurtrey et al. (1959) stated that the Bitterroot Valley probably originated in the Cretaceous period as a marginal flexure concurrent with the intrusion of the Idaho batholith. The present structure of the Bitterroot Valley was also caused by recurrent faulting along both margins of the valley. The Bitterroot River cuts through various terraces in the valley, leaving broad flood plains in many portions (Foote 1965 from McMurtrey et al. 1959). The valley floor is composed of Tertiary sediments that originated in the adjacent mountain ranges (McMurtrey et al. 1959).

The flood plain of the Bitterroot River is a system of intertwining swales, gravel bars, active and old river channels and numerous sloughs. This area is flooded or isolated by floods almost every spring during the peak runoff. Heavy flooding occurred along the Bitterroot River during the Spring and early Summer of 1974.

Upper portions of the Bitterroot Valley are composed of Pleistocene fans, benches, and moraines on the west side, and Tertiary benches on the east side (McMurtrey et al. 1959). The junction of the Lolo Creek Valley and the Bitterroot Valley is the site of a large alluvial fan. Here the

soils are a moderately deep, gravelly-sandy loam and represent the most intensively farmed land within the study area (U.S.D.A. 1959). Smaller fans occur at the mouths of Mormon Creek and Sleeman Creek.

Climate

The climate of the Lolo area is among the most pleasant in the State of Montana. Summers are cool and winters are mild when compared to similar intermountain valleys east of the continental divide. Hamilton, located 36 miles south of Lolo in the central Bitterroot Valley, has an average annual temperature of 45.1° F., an average January temperature of 24.1° F., and an average July temperature of 67.9° F. (U.S.D.C. 1965). Missoula, which occurs at the north end of the Bitterroot Valley, has temperatures that are slightly cooler (U.S.D.C. 1974).

Precipitation along the floor of the Bitterroot Valley normally varies from 12 to 15 inches per year (U.S.D.C. 1965). Snowfall is light in the lower valley, usually melting between storms except during periods of protracted cold spells. The winter climate on the lower slopes adjoining the Bitterroot Valley provide excellent winter range conditions for deer and elk.

History

The first white men to visit the Bitterroot Valley were the expedition of Lewis and Clark. The expedition spent the nights of September 9 and 10, 1805, camped near the junction of the Bitterroot River and Lolo Creek, calling the spot "travelers rest" (Coues 1893).

Trappers and traders soon followed Lewis and Clark to the Bitterroot Valley, and in 1841 St. Mary's Mission was established by Jesuit

Misionaries near the present-day town of Stevensville (Stevensville Historical Society 1971). The mission was sold in 1850 to Major John Owen who built a trading post near the mission. Fort Owen soon became the nucleus of a farming community (Cappious 1939).

By the late 1860s a wagon road existed between Stevensville and the newly-founded city of Missoula, 35 miles to the north. The completion of the Northern Pacific Railroad through Missoula in 1883 and the subsequent completion of the Bitterroot Branch in 1888 hastened the population growth of the Bitterroot Valley area (U.S.D.A. 1959).

The first ranch claim in the Lolo area was filed in 1866, and by 1885 there were at least five homesteads within the study area.[9] These early farms were to a large degree self-sufficient. Hay, wheat, potatoes, sheep, beef cattle, and dairy cattle were the principle commodities raised. Several large orchards had been planted in the Lolo area by the late 1890s. Mining and timber-cutting were other forms of enterprise in the decade before the turn of the century. By 1896, Lolo had a population of 100 people and included three churches, one hotel and a combination grocery store-post office (Missoula Planning Board 1973).

In 1908, the Northern Pacific Railroad began building a branch line up Lolo Canyon with the intention of connecting directly to Portland, Oregon. This was a massive project involving approximately 2,000 men and, as a result, Lolo became a boom town (Miller, Sept. 25, 1974, discussion). The project was abandoned the same year construction began, however, and Lolo's population soon declined.

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[9]Unpublished information taken from records in the Missoula County Courthouse by Elaine Mills, a Lolo resident.

Between 1900 and 1915, thousands of acres of orchards were planted in the Bitterroot Valley as part of a speculative land sales scheme (Cappious 1939). Orchard and potential orchard land was subdivided into units as small as five and ten acres, and then sold to a largely-Eastern clientele. The "Apple Boom" centered around Stevensville and by 1913 nearly the entire area of the east- and west-side benches was planted to orchards, most of which were apple (U.S.D.A. 1959).

The "Apple Boom" extended north to the Lolo area, and one such "subdivision" was platted but never developed in the northeast corner of Section 25. Most of the buyers of such orchard tracts never settled in the Bitterroot Valley and many eventually lost the title to their property through failure to pay taxes on the land. Much of the orchard land consequently was never split in any way but on paper (Cappious 1939).

Lolo was a busy community during the peak of the "Apple Boom." The train station was a disembarking point for many buyers and potential buyers who came to see the orchards (Miller, Sept. 25, 1974, discussion). In 1910 the 25.84 acre Delaney Subdivision was platted and filed, thus establishing the original Lolo townsite (Missoula Planning Board 1973). No further subdivisions were platted in Lolo until 1957.

Most Lolo residents continued to make a living from farming after the "Apple Boom" ended. Farms remained diversified with an emphasis on raising beef cattle. Many smaller farms were of the subsistence type (Miller, Sept. 25, 1974, discussion and Tucker, Mar. 2, 1975, discussion). Sugar beets, wheat, and other grains were planted in both the valley bottome and on the irrigated hillsides. Lolo had two dairy operations until the mid-1960s.

The Bitterroot Road was paved in 1951, improving access to and from the Bitterroot Valley and making it easier for people to live in the valley and commute to work in Missoula. By the late 1950s it is estimated that one-fourth of all farms in the Bitterroot area (Ravalli County only) were residential or part-time (U.S.D.A. 1959).

Nine residential subdivisions were platted within the study area between 1957 and 1963 (Table 2). The completion of Highway 12 leading from Lolo over Lolo Pass in 1964 and the improvement (to four lanes) of Highway 93 between Missoula and Lolo in 1968 hastened the subdevelopment of the Lolo area (Bugbee undated) so that between 1963 and 1971, 14 additional subdivisions were platted (Table 2).

The fact that there were 24 different subdivision plattings within the study area in July, 1973, is not readily observable in the field as 16 of these subdivisions represent portions of multiple plattings. Whenever a landowner subdivided his property on two or more different dates, a separate subdivision plat was filed in the clerk and recorder's office. For purposes of field evaluation and subsequent reference the 24 Lolo subdivisions were clumped into the following 13 categories: Delaney, Vann Ostrand, Valley Grove, Hughes, Kuney, Larson's Lolo Tracts, Mulhauser, Lolo Peak Vista, Mormon Creek Estates, Lake View, Rodeo Ranchettes, Greenwood, and West View. Henceforth "subdivision" will refer to one of these 13 areas (Table 2 and Figure 6, page 55).

The rapidity of subdivision development in recent years is shown by the fact that approximately 96 percent of the total 1971 subdivision acreage had been platted since 1957, 63 percent since 1964 and 51 percent

Table 2. Lolo area subdivisions 1895-1973[10]

Subdivision Name	Date Filed	Location (Section No.)	Total Acres[11]
Delaney	6/06/10	35	25.84
Vann Ostrand	8/22/57	34	72.00
Valley Grove	9/22/60	27	48.00
Hughes	10/10/60	35	23.00
Kuney	10/21/60	34	20.20
Larson's Lolo Tracts	11/07/60	35	15.40
Kulhauser Acres	11/07/60	22	19.30
Kuney No. 2	8/31/61	34	5.43
Kuney No. 3	4/23/62	34	8.25
Lolo Peak Vista No. 1	9/24/63	35	6.88
Lolo Peak Vista No. 2	2/16/65	35	14.80
Lolo Peak Vista No. 3	4/21/66	35	13.90
Lolo Peak Vista No. 4	9/14/65	35	3.21
Lolo Peak Vista No. 5	8/11/66	35	11.54
Lolo Peak Vista No. 6	4/24/67	35	5.00
Lolo Peak Vista No. 7	12/29/67	35	6.62
Lolo Peak Vista No. 8	12/30/68	35	18.87
Mormon Creek Estates	4/09/69	33	9.60
Lake View	1/18/69	26	98.13
Rodeo Ranchettes No. 1	6/18/69	25	19.24
Rodeo Ranchettes No. 2	12/02/69	25	88.78
Greenwood Addition	4/18/70	26	28.01
West View	1/15/71	27	81.79
Lolo Peak Vista No. 9	7/22/71	35	10.94
		Total	654.73

since 1968 (Figure 1). No additional subdivision platting occurred between August 1971, and the start of this study in July 1973.

Lolo today is essentially a suburb of Missoula. The area has a small commercial district which provides a few local services in the form of gas stations, bars, grocery stores and restaurants (Missoula Planning Board 1973). Surrounding this central district are the platted subdivisions,

[10]Table taken from "A Lolo Housing Study" (Bugbee undated).

[11]All acreages rounded off to two decimal places.

trailer courts, non-platted residential areas, and agricultural land. Approximately 71 percent of the household heads are employed outside of Lolo, 63 percent in Missoula (Missoula Planning Board 1973).

Between 1968 and 1973, the population of Lolo grew at the annual rate of approximately 18 percent (Missoula Planning Board 1973). Lolo's population in 1973 was approximately 2,000 individuals. Furthermore, 262 acres of platted subdivision land was vacant in 1973 (Missoula Planning Board 1973), indicating that even without the further platting of subdivisions, Lolo's capacity to attract more people is considerable.

Agricultural changes in the Lolo area show a trend from a diverse form of agriculture to one dominated by hay and beef cattle. This trend has occurred throughout Missoula County (Table 3). Potatoes, sugar beets and to a large extent wheat had disappeared from the study area by 1972. Wheat, however, has increased greatly in the Bitterroot Valley between 1973 and 1975.

Vegetation in 1973

Man has greatly changed the native vegetation of the study area. The addition of irrigation water during the summer months, the substitution of row crops and pasture in place of native species, grazing by livestock, wetland drainage, and subdivision land development are the most important change agents.

The slopes and benches east of the Bitterroot River are predominantly covered with grassland. Much of this area has been heavily grazed by sheep, horses and cattle and, as a result, the climax Agropyron and Festuca community types (Mitchell 1958) have declined in abundance over

Table 3. Some farm trends in Missoula County 1951-1971[12]

Year	Wheat Acres Planted	Barley Acres Planted	All Hay Acres Planted	Cattle and Calves Total Number
1951	12,800	5,400	25,400	14,100
1954	9,300	4,700	26,100	20,900
1957	6,000	6,900	29,300	21,700
1960	6,600	4,000	26,000	20,400
1963	6,100	4,800	30,700	21,700
1966	6,300	3,300	25,800	24,700
1969	5,900	2,200	31,700	24,000
1971	5,200	2,800	26,600	21,000

much of this area. Grazing pressure is by no means uniform, however, as the vegetative composition often changes markedly along fencelines.

Common grasses and forbs found within this grassland include bluebunch wheatgrass (Agropyron spicatum), Idaho fescue (Festuca idahoensis), cheat grass (Bromus tectorum), spotted knapweed (Centaurea repens), mullein (Verbascum thapsus), arrowleafed balsomroot (Balsamhoriza sagittata), leafy spurge (Euphorbia esula), tumbling mustard (Sisymbrium spp.), and yarrow (Achillea lanulosa). Shrubby species include big sagebrush (Artemesia tridentata), fringed sage (A. frigida), rubber rabbitbrush (Chrysothamnus nauseosus), bitterbrush (Purshia tridentata), and serviceberry (Amelanchier alnifolia).

Several small drainages cleave the slopes east of the river. On the northern exposures of these drainages are found narrow bands of coniferous forest. These forested areas are composed larely of the Douglas

[12]Data prepared by the Missoula County U.S.D.A. Committee for Rural Development, undated, "Some Agricultural Trends in Missoula County" Cooperative Extension Service, Missoula, Montana.

fir (Pseudotsuga menziesii)-snowberry (Symphoricarpos albus) habitat type and the Douglas fir-ninebark (Physocarpus malvaceus) habitat type (Pfister et al. 1974).

A ponderosa pine (Pinus ponderosa)-bluebunch wheatgrass habitat type (Pfister et al. 1974) occurs on the lower west facing slopes in Sections 22 and 23. This habitat type has a savannah growth form.

Drainages that contain surface water during the summer months are found on both sides of the Bitterroot and Lolo Creek Valleys. These drainages are dominated by riparian species, the most common of which are black cottonwood (Populus trichocarpa), quaking aspen (P. tremuloides), hawthorn (Crataegus douglasii), wild rose (Rosa spp.), willow (Salix spp.), and mountain maple (Acer glabrum).

The lower slopes on the west side of the Bitterroot Valley also contain both coniferous forest and grassland communities. Forested areas, however, extend to lower elevations on the west side. Coniferous forest areas on the west side of the Bitterroot Valley consist largely of Douglas fir-ninebark and Douglas fir-snowberry habitat types. Western larch (Larix occidentalis) is abundant in the Douglas fir-snowberry habitat type that lines Mormon Creek where it enters the study area. This habitat type changes to a riparian shrub community after the Mormon Creek drainage opens into a meadow (Section 4). On the south-facing slope adjacent to Mormon Creek, a Douglas fir-pinegrass (Calamagrostis rubescens) habitat type (Pfister et al. 1974) occurs.

Water is taken by irrigation ditch from Mormon Creek and Lolo Creek by extensive ditch systems. These ditches are lined with groves of cottonwood and aspen and are located primarily on the hillsides south

of Lolo Creek. None of the study area east of the Bitterroot River is irrigated except that which is within the Rodeo Ranchettes Subdivision (Section 25).

Native grasses and forbs commonly found on the hillsides west of the Bitterroot River include bluebunch wheatgrass, Idaho fescue, rough fescue (Festuca scabrella), prairie junegrass (Koeleria cristata), needle-and-thread grass (Stipa comata), cheatgrass, mullein, arrowleafed balsamroot, and spotted knapweed. Fringed sage is spread throughout these grasslands and big sage is the dominant vegetative species on the rocky south-facing slope that overlooks Lolo Creek in Section 34. The northeast quarter of Section 3 has been so heavily grazed that few climax frass species remain.

Small acreages of introduced grasses and legumes have been planted on the slopes and benches west of the Bitterroot River. These species include alfalfa (Medicago sativa), thickspike wheatgrass (Agropyron cristatum) and intermediate wheatgrass (A. intermedius). None of these plantings are irrigated.

The vegetation within the floodplains of the Bitterroot River and Lolo Creek form a dense growth in many places. Forested areas are dominated by cottonwood in the overstory but also contain ponderosa pine, aspen, and water birch (Betula occidentalis). Shrub species form a second vertical layer under the forest canopy and also grow in dense stands independent of the larger tree species. Important shrub species in these floodplain areas are alder (Alnus tenuifolia), willow, serviceberry, red osier dogwood (Cornus stolonifera), hawthorn, and wild rose.

Sloughs and marshy areas are characterized by thick stands of cattail (Typhus spp.), willow and alder. Adjacent to these sloughs and marshes are wet meadows containing abundant sedges (Carex spp.), rushes (Juncus spp.), and grasses tolerant of standing water. Raised areas within the wet meadows are often covered with cheatgrass and spotted knapweed because they receive heavy grazing pressure by cattle.

Open areas within the floodplains of the Bitterroot River and Lolo Creek are often utilized for hay or pasture. These areas are usually irrigated and are planted with Timothy (Phleum pratense), clover (Trifolium spp.), alfalfa, and bluegrass (Poa spp.).

Alfalfa and irrigated pasture are the most commonly raised crops within the study area. Other crops include barley (Hordeum vulgare), oats (Avena sativa), and corn (Zea mays). A few small apple orchards still remain but most are in a deteriorating condition. In addition to these crops, most farmers and many other residents of the Lolo area have large vegetable gardens.

CHAPTER IV

METHODS

Base Map

A topographic map mosaic of the study area was made by taping together four U.S.G.S. 7.5 minute topographic maps (scale: 2.64 inches to the mile). The mosaic was then photographed to produce a 10 inch by 12 inch negative, and the negative was enlarged to a scale of 4 inches to the mile. A positive print, also with a scale of 4 inches to the mile, was produced from the negative. This positive print was screened using a 30 percent chrome screen tint so that the contour lines would be lightened. Blackline prints were made from the screened positive.[13] These blackline prints served as a base map for a variety of purposes: locating field observations, depicting observation routes, mapping cover types, and locating property boundaries.

Aerial Photographs

Aerial photographs were used to identify cover types, to prepare a land use map for 1937, and to measure the acreages of each cover type destroyed or altered by subdivision land development. Three sets of aerial photographs of the study area were obtained: July 7, 1937, at a scale of 3.168 inches to the mile (RF 1:20,000); July 17, 1964, at a scale of 4 inches to the mile (RF 1:15,840); and August 8, 1972, at a

[13]The Missoula Blueprint Company, 1613 South Ave. W., Missoula, Montana 59801, was employed to produce the blackline prints from the topographic mosaic.

scale of 1 inch to the mile (RF 1:63,360).[14] The 1972 aerial photographs were enlarged to a scale of 2 inches to the mile (RF 1:31,680) for use in this study.

The set of 1937 aerial photographs on file at the Forest Service Division of Engineer's Office in Missoula already had the section lines superimposed. These section lines were transferred onto my set of 1937 aerial photographs. Section corners on the Forest Service prints had been field-checked and were considered quite accurate. Many section lines and corners were quickly identifiable by fence lines and roads and were easily transferred.

Section corners that were not easily identified were located by triangulation. The distances between two easily transferred section corners and the section corner in question was measured from Forest Service prints, using a draftsman's compass. These two measurements were transferred to the study prints as the radius of the compass arc. The point where two arcs intersected identified the section corner.

Section lines were also transferred onto the 1964 and 1972 aerial photographs using the lines on the 1937 aerial photographs as references. Considerable difficulties were encountered because of scale differences between the three sets of photographs, and because the section corners delineated on the 1937 aerial photographs were sometimes not identifiable on the aerial photographs shot at a later date. A high degree of accuracy

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[14]The 1937 and 1972 aerial photographs were purchased from the U.S. Forest Service Division of Engineers, Geometronics Branch, Federal Building, Missoula, Montana. The 1964 aerial photographs were purchased from the Western Aerial Photography Laboratory, U.S. Agricultural Stabilization and Conservation Service, 2505 Parleys Way, Salt Lake City, Utah.

was not necessary in drawing the section lines on these later photographs, however, as no map was to be made from them. In some instances, when two adjacent corners could not be identified in the 1964 and 1972 aerial photographs, the section line between them was left out.

Ownership Maps

Two ownership maps were drawn, one for 1937 and one for 1973. These dates show the ownership boundaries (including platted subdivisions) that existed prior to the period of recent subdivision platting in Lolo (1957-1971), as well as the ownership boundaries immediately after this period. The ownership maps allow one to determine where property subdivision was occurring within the study area. They also show the magnitude of such subdivision in relation to the size of adjacent undeveloped areas.

The format for these ownership maps was proposed in "A Resource Inventory Method" (Montana Department of Natural Resources 1973). Property boundaries delineated on the maps included: state lands, platted subdivisions, corporately owned land, and private land exclusive of platted subdivisions (including utility, commercial and industrially owned property). Roads and highway boundaries, utility easements, and utility plats less than one acre in size were not included, nor were the individual property boundaries within the platted subdivisions.

Property boundaries for the study area were obtained from township plat books and Certificates of Survey at the Missoula County Assessor's Office. Two separate sets of plat books were available, an older set that showed the property boundaries through 1964, and a newer set that showed

the property boundaries in 1973. The older set was used in drafting an ownership map for 1937 and the newer set in drafting a similar map for 1973. Only those deeded transfers shown in the plat books were recorded. When questions arose concerning the acreage or date of a property division, reference was made to the responding deed or certificate of survey on file in the assessor's office.

A considerable scale reduction had to be made in transferring the property boundaries on the section maps in the plat books to the base map. For extensively subdivided sections such as those in central Lolo, the property lines were first transferred onto duplicate section maps purchased from the County Surveyor's Office. The necessary scale reductions were then later made with the aid of a calculator.

The acreage for each property parcel was also recorded on the ownership maps. Where strip properties such as roads, utility easements, and the Bitterroot River separated two or more ownerships, the acreage of the strip property (if recorded) was divided proportionally among the adjacent ownerships. Similarly, when such strip property bisected an ownership, the acreage of the strip property was added to the acreage of the parcel that it bisected. The same procedure was followed for utility plots less than one acre in size.

Often, the total for all the property ownerships and portions of ownerships within a section added up to a total acreage less than the acreage total for the section as recorded in the plat book.[15] In such

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[15]The study area was 10,188.78 acres in total area. Twelve of the sections had 640 acres; sections 1, 2, 3, and 4 had 639.70, 637.98, 622.32, and 608.78 acres respectively.

cases, the difference was always added to the largest property parcel within the sections; the rational used here was that after examination of the section maps in the plat books, it appeared that most of these "missing acres" were in roads, easements, and the Bitterroot River, and not in small property subdivisions.

Cover Typing

There is a large amount of literature describing methodologies for using aerial photographs in cover type mapping. Some authors categorize cover types based on ecological origin (Dalke 1937) or climax vegetation (Graham 1945), while others use mapping symbols showing only the current state of vegetation (MacConnel and Garvin 1956, Sheldon 1959, Caslick 1972). The cover typing system used in this study was based on the last of these three methods, since the Lolo area has been widely disturbed by man and the vegetative ecological progressions have been set back over much of the study area.

Before delineating cover types on the aerial photographs, several weeks were spent in becoming familiar with the study area. Many Lolo residents were questioned about wildlife trends and land use changes that had occurred. In addition to this interviewing, all 16 sections within the study area were thoroughly traversed during these early weeks.

The cover typing categories used were patterned after those proposed by the Montana Department of Natural Resources (1973). Since land use change was an important part of this study, land use was emphasized in choosing these categories. Table 4 lists the cover types delineated on the aerial photographs. Unless otherwise specified, "cover type" will

henceforth refer to both the cover type and cover subtype as listed in Table 4.

Table 4. Cover types identified on the aerial photographs

Type	Subtype
Agricultural	farmstead orchard non-irrigated cropland and pasture irrigated cropland and pasture non-cultivated valley grassland
Rangeland	predominantly grasses and forbs predominantly shrubs ponderosa pine savannah
Forest	deciduous coniferous mixed
Wet Areas	marshes and sloughs wet meadows rivers and streams
Sandbars and Gravel Pits	sandbars gravel pits
Transportation Corridors	highways county roads railroads
Residential and Commercial Areas	

Cover types were first delineated with ink on the 1972 aerial photographs. The 1937 and 1964 aerial photographs were often helpful in clarifying these delineations as they were of a considerably larger scale than the 1972 photographs. Also, the study area was small enough so that virtually all of the cover type units delineated on the 1972 aerial photographs were ground checked during the course of the study. As each of these cover type units was ground checked, the specific vegetative components within

the unit were recorded in the field notes (i.e., alfalfa field, douglas fir-snowberry habitat type, etc.).

Following the delineation of cover types on the 1972 aerial photographs, cover types were outlined on the aerial photographs for 1937 and 1964. The principal changes between 1937 and 1972, aside from the increase in residential land use, were changes in agricultural use of the land. The Manual of Photographic Interpretation (American Society of Photogrammetry 1960) was used extensively for identifying the agricultural cover types in these early aerial photographs. Also, whenever possible, the agricultural landowners were consulted for help in identifying the 1937 and 1964 cover types.

A 1937 land use map was made by using a topographic print as a base map. Each section on both the aerial photograph and on the base map was gridded into 40-acre units. Areas with a complex of small cover type units were gridded into even smaller units, with 5 acres being the minimum unit size. Cover types were then transferred onto the base map by hand using the available topographic and planimetic reference points as guides. With the exception of orchards and farmsteads, 5 acres was the approximate minimum size for a cover type unit included on the 1937 cover type map.

In transferring cover types directly from aerial photographs onto a topographic map of a different scale, it is not accurate to make the transfer by simply adjusting the photographic scale to the base map scale (Caslick 1972). Slight distortions often occur on the surface of the aerial photograph as a result of changes in the position and tilt of the airplane. It is necessary, therefore, to locate reference points and

distances on the topographic map so that cover type boundaries may be accurately mapped (MacConnel and Garvin 1956, Caslick 1972).

The section lines on both aerial photographs and the base map served as a good general reference framework (grid). References for smaller areas included contour lines, ridgetops, drainages, roads, and property lines. Changes in agricultural cover types often occurred along property boundaries. Thus, the 1937 ownership map was quite useful in mapping such agricultural areas since the two maps had the same scale.

Measurement of Cover Type Change

Most of the cover types delineated on the aerial photographs and cover type maps represent habitat to many wildlife species. Wherever a subdivision land development occurs, homes and roads replace or alter much of the cover types formerly within the boundaries of the subdivision. Information concerning the habitats disturbed or destroyed was obtained by measuring the total acreage of each cover type replaced or altered by such subdivisions.

To facilitate the taking of such measurements, an acetate copy of the 1972 ownership map was overlayed onto the 1937 cover map. Where the cover type replaced or altered by the subdivision was uniform, the total acreage for the subdivision was recorded as being equal to the number of acres of the cover type replaced. Where more than one cover type formerly occupied the site of a subdivision, a polar planimeter was used to measure the acres of each cover type replaced. For example, the entire Hughes subdivision (Section 35) was located on 23 acres of irrigated pasture

while the entire Kuney subdivision was located on a combination of 19 acres of riparian forest and 15 acres of wet meadow.[16]

The cover type present when the subdivision land disturbance occurred was not always the same as the cover type indicated on the 1937 cover type map. In such cases, the cover type and cover type acreages were taken either from the 1964 aerial photographs (using a polar planimeter) or from interviews with the subdivider or the prior landowner.

Field Observations

Six routes were chosen for the purpose of making field observations. These are shown in Figure 3. The routes traversed areas within and adjacent to Lolo subdivisions and other residential sites. They also covered parts of the study area separated from homesites by either distance (up to one and one-half miles) or natural barriers such as the Bitterroot River. Each route was designed so that it traversed a variety of cover types.

Route 1 begins along the Bitterroot River in the extreme northern portion of the study area. Heading south, the course traverses the steep slopes and benchland immediately to the east of the Bitterroot River, and returns through an area of riparian forest and sloughs. The southern portion of the route is directly across the river from the Greenwood Addition Subdivision and approximately one-half mile northwest of the Rodeo Ranchette Subdivision. A steep slope separates this portion from the Rodeo Ranchette Subdivision. Three principal cover types are found along

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[16] In measuring land use change, all acreage figures are rounded off to the nearest acre.

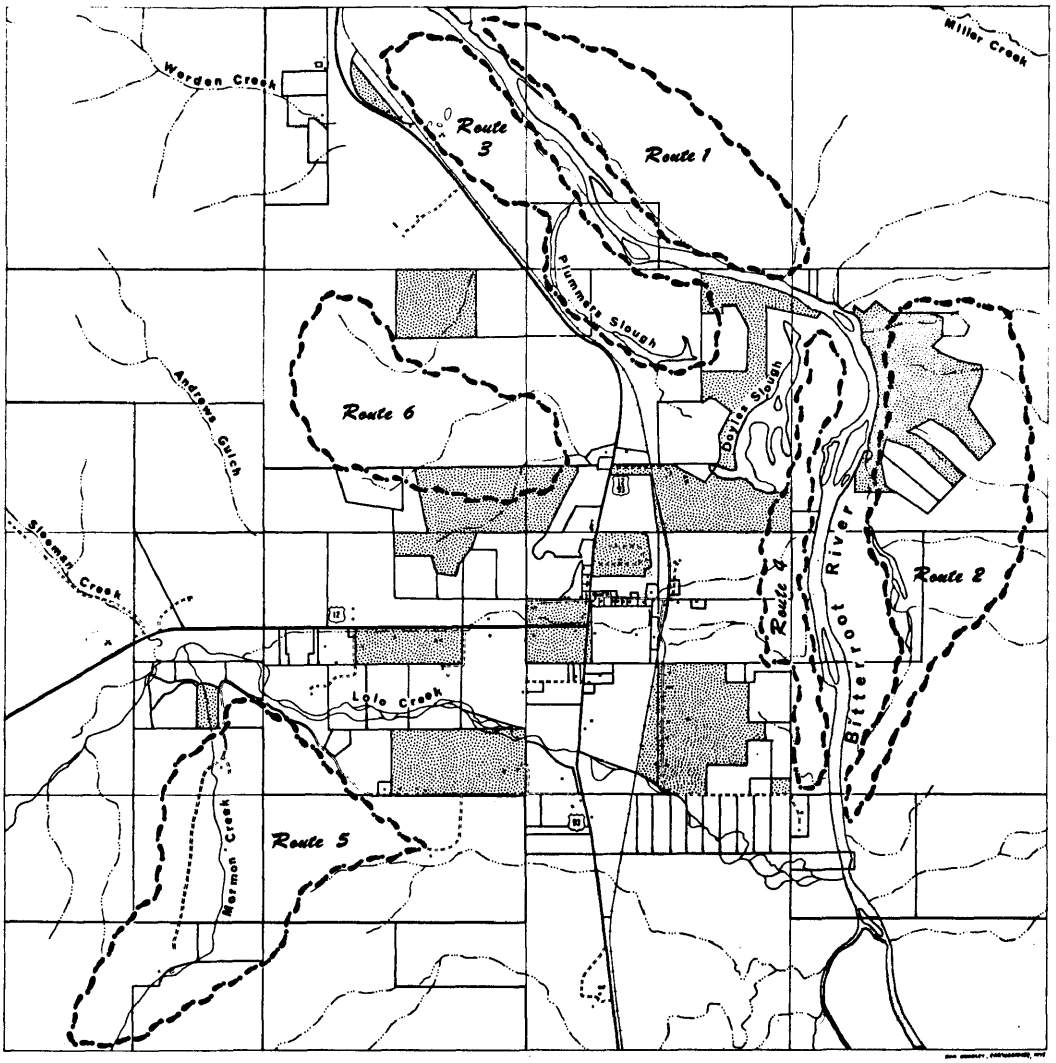

Figure 3. Observation Routes Within the Study Area

route 1: ponderosa pine savannah, grass-forb rangeland and deciduous forest. This course lies almost entirely within the Dan Maloney ranch and all of the route was grazed by cattle during the period of the study.

Route 2 begins on the slope to the east of the Rodeo Ranchette Subdivision. The course heads south, traversing steep slopes and drainages and then descends to the narrow floodplain area on the east side of the river. After descending to the river, route 2 heads north along the floodplain and crosses through the Rodeo Ranchette Subdivision. This route is separated from the Lake View and Greenwood Addition Subdivisions by the Bitterroot River and by a long, narrow strip of deciduous forest on the west bank of the river. The principal cover types along route 2 include: deciduous, mixed, and coniferous forest: shrub and grass-forb rangeland; marsh and slough; wet meadow; non-cultivated valley grassland; and residential area. Excluding the portion within the Rodeo Ranchette Subdivision, route 2 traverses land belonging to four different owners. Much of this course was grazed by cattle and horses.

Route 3 begins on the west side of the Bitterroot River, to the north of the Lake View and Greenwood Subdivisions. The course makes a loop through a broad floodplain area of mixed cover types and ends by crossing through the Greenwood Addition Subdivision. Much of the land along route 3 is currently in agricultural usage, predominantly cattle and hayfields. The main cover types along route 3 include non-irrigated cropland and pasture, mixed forest, marsh and slough, wet meadows, and residential area. Excluding the portion within the Greenwood Subdivision, route 3 traverses land belonging to five different land owners. Much of

the route, including the Greenwood Subdivision, was inundated during the June flooding in 1974.

Route 4 begins just east of the Lolo Peak Vista Subdivision along the Bitterroot River. Leading north and then south through the Bitterroot Valley the course intersects or is adjacent to the Greenwood, Lake View, Hughes, and Lolo Peak Vista Subdivisions. The cover types along route 4 include deciduous forest; irrigated and non-irrigated cropland and pasture; wet meadow; and residential area. Sheep, beef cattle and alfalfa hay are the principal commodities raised in this area. Excluding subdivisions, Route 4 intersects five ownerships.

Route 5 begins at the farmstead of the Gerald Tucker ranch and leads up the ridge separating the Bitterroot Valley from Mormon Creek. After crossing the ridge, the route traverses the eastern slope of the Mormon Creek drainage for about one-half mile, crosses the Mormon Creek Valley and then traverses the slope and benchland to the west of the valley. Route 5 was designed to assess the wildlife and wildlife habitat within and adjacent to a low density housing area. The portion of the Mormon Creek Valley above the Mormon Creek Estates has but four residences. Route 5 intersects a total of seven separate ownerships. Cover types along the route include: grass-forb rangeland; shrub rangeland; mixed, coniferous, and deciduous forest; orchard; and non-irrigated pasture.

Route 6 is located west of the Bitterroot River in the foothills of the Graves Creek Range. Beginning within the West View Subdivision, the route leads north towards the Valley Grove Subdivision, crossing both open and forested areas. After traversing the land to the west of the Valley Grove Subdivision, route 6 circles back to its point of origin.

The principal cover types along this route include grass-forb rangeland, coniferous forest, non-irrigated pasture, and residential area. Excluding the West View Subdivision, route 6 bisects three ownerships. Much of this route was grazed by beef cattle during my study.

For the sake of consistency and uniformity in my field observations, the six routes were walked in a consecutive order and then repeated. Each route was walked in the morning beginning as early as 6:00 a.m. and ending no later than 1:00 p.m., with generally no more than one route walked per day. Portions of the study area not included along a route were also visited during the course of the study, but much less frequently. Unique habitat areas not within one of the six routes were the coniferous forest in Section 21 and the wet areas in Section 2.

Field observations began in July, 1973, and ended in January, 1975. Of the 115 mornings spent walking the routes, 42 percent were walked during the summer months, 16 percent during the fall, 32 percent during the winter, and 14 percent during the spring.

All field observations were recorded in a loose-leaf binder and then later recopied into a bound hardback notebook. A copy of the topographic base map was cut into sections, one for each route, and these were used to record specific locations such as den sites or carcasses. Observations were aided by the use of 7 x 25 binoculars and a 25X spotting scope.

The effects of residential land development upon a limited number of birds and mammals in the Lolo area was considered. These species included the elk, white-tailed deer (Odocoileus virginianus), black bear (Ursus americanus), coyote (Canis latrans), red fox (Vulpes vulpes),

beaver (Castor canadensis), ring-necked pheasant (Phasianus colchicus), ducks (Family: Anatidae) and Canada goose (Branta canadensis). Species considered to a lesser extent included the moose (Alces alces), striped skunk (Mephitis mephitis), muskrat (Ondatra zibethicus), red-tailed hawk (Buteo jamaicensis), bald eagle (Haliaetus leucocephalus), common crow (Corvus brachyrhynchos), black-billed magpie (Pica pica), Hungarian partridge (Perdix perdix), ruffed grouse (Bonasa umbellus), great blue heron (Ardea herodias), and Lewis' woodpecker (Asyndesmus lewis).

In establishing a pre-subdivision baseline for species abundance and diversity, information concerning game and furbearer species residing in the Lolo area was the most bountiful and emphasis was therefore placed on studying the impacts of subdivision on the numbers and habitats of such species. The paucity of information on non-game species and non-furbearers is unfortunate. Various wildlife resource agencies have recently expressed a need to conserve non-game as well as game habitat. Non-game species such as perching birds and various rodents, furthermore, are often the most visible to residents of subdivided areas.

The nature of field observations can be broken into three general categories: wildlife and wildlife habitat, dogs and other domestic animals, and human use of areas adjacent to the subdivisions. The names and locations of each bird and mammal species observed along a route were recorded for each morning in the field. Other wildlife information gathered included the location of animal tracks, feces, and feeding sign, and the sites of nests, den sites, and bedding areas. Emphasis was placed on recording animal locations in relation to subdivisions and careful attention was devoted to signs of harassment of wildlife by domestic animals

or people. Appendix B lists all the birds and mammals seen in the field and the route or routes in which they were seen.

Whenever unattended dogs were observed or heard in areas away from residential sites, the location was recorded. An attempt was also made to judge the apparent nature of each dog's activity.

Human use patterns in areas adjacent to subdivisions were determined by recording the dominant human activity in these areas. Such activities included walking, horseback riding, riding snowmobiles and motorcycles, hunting, and trapping. Illegal trespass and vandalism were also recorded.

Interviews

Equal in importance to field observation was a reconstruction of wildlife trends. Interviews were therefore conducted with many residents of the study area. These interviews yielded information covering land use changes, changes in animal numbers, the seasonal habitats (including migration routes) of various bird and animal species, evidence of wildlife harassment, and local hunting pressure.

Most of those interviewed had been residents of Lolo for at least 15 years and most were owners of more than 80 acres. Information obtained from one resident was always compared with similar information provided by others so that any differences could be reconciled. Additional sources of information used in assessing wildlife trends in the Lolo area included interviews conducted with local wildlife biologists employed by the Montana Fish and Game Department and the U.S. Forest Service.

Aerial counts, browse and pellet group surveys, check station data, and other related information provided by the Montana Fish and Game Department was of limited use. Such data tended to show trends for regions much larger than the study area.

CHAPTER V

RESULTS

Changes in Ownership Patterns

Approximately 6.4 percent or 654.73 acres of the study area were part of platted subdivisions in July, 1973. Even when one adds to these acreages the many residential or commercial acreages which are not part of platted subdivisions, the Lolo area is still dominated by agricultural and range lands. The non-developed acreage in Lolo, however, is interspersed with many dense residential areas (Figures 4 and 6).

The increase in platted subdivisions and other predominantly residential acreages in Lolo is evident from viewing the 1937 and 1973 ownership maps (Figures 3 and 4). Table 5 quantifies this increase by breaking the separate ownership parcels into the following size categories: less than 10 acres, 10-20 acres, 20-40 acres, 40-80 acres and 160 acres or greater.[17]

In 1937, 96.5 percent (9830.96 acres) of the study area was divided into ownership parcels of 80 acres or larger, while less than one percent (78.39 acres) was divided into parcels smaller than 20 acres (Table 5). In the following 46 years this pattern changed considerably as the 80-160 acre and greater than 160 acre categories lost acreage to those four categories

[17] An ownership parcel may be defined as the total number of acres belonging to one owner that is contained in one unit. Platted subdivisions are considered in the "less than 10 acre" category. Some of the lots within a platted subdivision, however, may be larger than 10 acres.

Figure 4.
Land Use Within the Study Area
1937

- Farmstead
- Orchard
- Irrigated Cropland and Pasture
- Non-Irrigated Cropland and Pasture
- Non-Cultivated Valley Grassland
- Predominantly Grasses and Forbs
- Predominantly Shrubs
- Ponderosa Pine Savannah
- Deciduous Forest
- Coniferous Forest
- Mixed Forest
- Wet Meadows
- Marshes and Sloughs
- Sandbars
- Gravel Pits
- Residential and Commercial Areas

N

SCALE

2000 1000 0 1000 2000 3000 4000 5000 FEET

.5 .4 .3 .2 .1 0 .25 .50 .75 1.0 MILES

R.F. 1:31,680

Figure 5.
Property Boundaries Within the Study Area 1937

- Hard Surface Road
- Graveled or Graded Road
- Section Line, Surveyed
- Property Boundary
- Topographic Contours
- Intermittent Streams
- Perennial Streams
- Private Ownership
- Platted Subdivisions
- Corporate Ownership
- State of Montana Ownership

N

SCALE

2000 1000 0 1000 2000 3000 4000 5000 FEET

.5 .4 .3 .2 .1 0 .25 .50 .75 1.0 MILES

R.F. 1:31,680

Figure 6.
Property Boundaries
Within the Study Area
1973

- Hard Surface Highway
- Unimproved Road
- Section Line, Surveyed
- Property Boundary
- Topographic Contours
- Intermittent Streams
- Perennial Streams
- Private Ownership
- Platted Subdivisions
- Corporate Ownership
- State of Montana Ownership

N

SCALE

2000 1000 0 1000 2000 3000 4000 5000 FEET

.5 .4 .3 .2 .1 0 .25 .50 .75 1.0 MILES

R.F. 1:31,680

Table 5. Property ownership size categories in Lolo for 1937 and 1973

Parcel Size (acres)	December 31, 1937[18] (acres)	December 31, 1973[18] (acres)	Difference (acres)
160.00+[19]	8,769.43	7,316.37	-1,453.06
80–159.99	1,061.53	780.05	- 281.48
40– 79.99	189.00	484.15	+ 295.15
20– 39.99	90.43	309.22	+ 218.79
10– 19.99	10.00	440.64	+ 430.64
0– 9.99	68.39	858.35	+ 789.96
	10,188.78	10,188.78	0.00

of less than 80 acres. In 1973 only 79.5 percent of the study area (8096.42 acres) was divided into parcels larger than 80 acres, while 12.7 percent (1298.99 acres) was divided into parcels 20 acres or smaller in size.

Field observations showed that most ownership parcels less than 20 acres in size are either residential or commercial in use. The total amount of acreage representing ownership parcels less than 20 acres in size increased by approximately 1220 acres in the 46-year period between 1937 and 1973 (Table 5). Approximately 629 acres of this increase are represented by platted subdivisions while much of the remaining 591 acres represents either residential or commercial land not within platted subdivisions.

[18] Acreage sizes are all rounded off to two decimals; acreages are inclusive of roads, highways, railroads, and utility easements.

[19] All property boundaries that do not fall entirely within the study area are larger than 160 acres and hence are included in this category with the exception of one parcel in Section 4 which falls into the "80–159.99 acre" category.

Location of Subdivisions

Subdivisions are unevenly distributed within the study area. One is located east of the Bitterroot River and nine of the 13 are located in either the Bitterroot or Lolo Creek Valleys. These nine subdivisions comprise approximately 62 percent (407.31 acres) of the total subdivided acreage.

Although there are only three subdivisions located on the foothills of the Sapphire and Grave Creek Ranges, these accounted for 36 percent (237.82 acres) of the total subdivision acreage. Only one subdivision, a 9.60 acre development in lower Mormon Creek (Section 33), is located in the Bitterroot Range portion of the study area.

Concentrations of non-subdivision residential acreages are located in the Mormon Creek area, the lower Worden Creek area, along the county road in central Lolo (Section 35), and along highways 12 and 93. The nine rectangular ownerships along the northern boundary of Section 2 are not used for residential purposes but instead represent the multiple division of one family ownership parcel among three sons (Figure 6).

Differences in topography (see Chapter II), ownership, and access between the east and west sides of the Bitterroot River account for the disproportionate amount of residential development on the western side. Within one-half mile to the west of the Bitterroot River there are 26 ownership parcels and four subdivision areas. By comparison, within one-half mile of the eastern bank there are nine ownership parcels and one subdivision (Rodeo Ranchettes). Furthermore, the Rodeo Ranchette Subdivision and the three adjoining parcels in the northwest corner of Section 25 were the only residential developments within the study area on the east side of

the river. Residential development was considerably more spread out west of the river (Figure 6).

The residential areas east of the river are accessible only by a long gravel road, and commuting time to Missoula is approximately 30 minutes. In the summer of 1973 only six of the 49 lots in the Rodeo Ranchettes contained houses. By comparison, the residential areas west of the river are accessible by paved streets and highway 93 and commuting time to Missoula is 15 to 20 minutes. The four subdivisions within one-half mile of the western bank had incurred residential building on better than 75 percent of their lots by the summer of 1973.

Cover Types Disturbed by Subdivision Development

Table 6 shows the cover type acreages within each of the 13 subdivisions prior to land disturbance, and Table 7 summarizes this information by showing the total acreage of each cover type and subtype disturbed or destroyed by platted subdivisions. The boundaries of the 13 subdivisions contained the following cover types prior to land disturbance: 265 acres of agricultural land, 213 acres of rangeland, 102 acres of forest, 68 acres of wet areas, and 7 acres of sandbar. These figures do not equal the acres of each cover type destroyed by subdivisions as some of the Lolo subdivisions are only partially developed.

The three foothill subdivisions (located in Sections 25, 26, 27 and 34) accounted for the entire 213 acres of rangeland occupied by subdivisions within the study areas in 1973 (Table 7). Each of these subdivisions was also platted on a small amount of coniferous forest.

Table 6. Cover type acreages within each subdivision prior to land disturbance

Subdivision	Total Acreage[20]	Cover Type and Acreages
Delaney	26	irr. past.-14, decid. for.-12
Vann Ostrand	72	irr. past.-63, decid. for.-7, farmstead-2
Valley Grove	48	grass-forb range-36, conif. for.-10, p. pine sav.-2
Hughes	23	irr. past.-23
Kuney	34	irr. past.-19, decid. for.-15
Larson's Lolo Tracts	15	decid. for.-12, irr. past.-3
Mulhauser	19	non-irr. past.-14, wet meadow-4, decid. for.-1
Lolo Peak Vista	92	non-irr. past.-44, wet meadow-42, non-cult. grassland-5, farmstead-1
Mormon Creek Estates	10	irr. past.-9, decid. for.-1
Lake View	98	irr. past.-60, wet meadow-13, mixed for.-12, marsh-slough-7, farmstead-6
Rodeo Ranchettes	108	grass-forb range-95, conif. for.-7, mixed for.-3, decid. for.-3
Greenwood	28	mixed for.-17, sandbar-7, non-cult. grassland-2, wet meadow-2
West View	82	grass-forb range-80, conif. for.-2
	655	

Ten subdivisions were platted either partially or entirely on agricultural land. Irrigated pasture and cropland (191 acres) and non-irrigated pasture and cropland (58 acres) were the two principal agricultural cover types involved in these plattings. The Lake View Subdivision (Section 26) replaced approximately 60 acres of cornfield and the Hughes Subdivision

[20] All acreage figures are rounded off to the nearest acre.

Table 7. Total cover type acreages occupied by subdivisions

Cover Type or Subtype	No. Acres[21]	No. of Subdivisions
Grass-forb rangeland	211	3
Irrigated pasture and cropland	191	7
Wet meadow	61	4
Non-irrigated pasture and cropland	58	2
Deciduous forest	51	7
Mixed forest	32	3
Coniferous forest	19	3
Farmstead	9	3
Non-cultivated valley grassland	7	2
Marsh-slough	7	1
Sandbar	7	1
Ponderosa pine savannah	2	1
Total	655	
Total agricultural	265	10
Total rangeland	213	3
Total forest	102	11
Total wet area	68	4
Total sandbar	7	1
Total	655	

(Section 35) was platted on acreage that was planted, at different times, to peas and grain. The other subdivisions platted on agricultural cover types replaced mostly hay crops or pasture. Seven subdivisions were platted at least partially within riparian habitats. The Kuney (Section 34), Vann Ostrand (Section 34), and Larson's Lolo Tracts (Section 35) Subdivisions

[21]All acreage figures are rounded to the nearest acre.

occupied a total of 34 acres of deciduous forest along Lolo Creek, while 61 percent (17 acres) of the Greenwood Subdivision (Section 26), and 12 percent (12 acres) of the Lake View Subdivision (Section 26) are located within the riparian forest strip along the Bitterroot River. Other subdivisions partially occupying riparian habitats are Mormon Creek Estates (Section 33) and Mulhauser (Section 22). The Lolo Peak Vista Subdivision borders the riparian forest along Lolo Creek to the south and along the Bitterroot River to the east.

Four Lolo area subdivisions occupy marsh or wet meadow cover types. The largest of these is the Lolo Peak Vista Subdivision (Section 35) which was partially platted in a bog-meadow containing numerous small sloughs. Because of the high water table in this area, portions of the Lolo Peak Vista Subdivision were built on dirt fill.

The northern extension of the Lake View Subdivision adjoins Doyle's Slough—an old oxbow river channel (since renamed "Hayden Lake"). Doyle's Slough was dredged by the subdeveloper and the dredgings were deposited around the perimeter of the slough to provide an elevated base for homesites. Approximately 20 acres of marsh and wet meadow cover types were "filled" with such dredgings within the boundaries of the Lake View Subdivision. Marsh and wet meadow cover types to the east of Doyle's Slough were also filled with dredgings in preparation for future subdivision plattings.

Other subdivisions that were platted partially within marsh-slough or wet meadow cover types are the Greenwood development which adjoins the northern extension of the Lake View Subdivision along Doyle's Slough, and the Mulhauser Subdivision in the far northern portion of the study area (Section 22).

Wildlife Use of the Study Area: Observations and Interviews

Elk

The foothill slopes surrounding Lolo have historically been used by elk during the winter and early spring months. Though not as commonly seen in some parts of the study area as they were in the 1950s and 1960s, elk continue to use these slopes during the spring greenup and during periods of extreme cold or deep snow. A large portion of the elk winter range in the Lolo area is on private property and is subject to agricultural use as well as subdivision development. The elk in the Lolo area may be divided into three assemblages: a Grave Creek Range group, a Bitterroot group, and a Sapphire group.

All landowners interviewed as well as local biologists with the Montana Fish and Game Department (Hartkorn and Janson, July 10, 1973, discussion) felt that elk use in the Grave Creek Range portion of the study area had decreased in recent years. One Lolo Creek rancher recalls that in the 1950s it was not unusual to see more than 50 elk in a bunch on the hill behind his ranch (Denton, Aug. 8, 1973, discussion). Another Lolo resident who lives in the Worden Creek area counted 42 elk bedded near his house in the mid-1960s (Hill, Mar. 8, 1975, discussion). Most landowners interviewed felt that 40 was a large group of elk in the Grave Creek Range portion of the study area during the early to mid-1960s, while 20 would be considered large today.

The Valley Grove and West View Subdivisions, totaling 130 acres, are built within elk winter range. On January 15, 1974, following nearly a week of subzero temperatures, I observed 15 elk, all cows and calves, feeding on a ridgetop on the southwest quarter of Section 27. This

sighting was approximately one-quarter mile to the northwest of the West View Subdivision.

On February 13, 1974, following another "cold snap," I observed approximately 12 sets of elk tracks bisecting the extreme western corner of the West View Subdivision, an area that was not yet built up with homes.

During the week of January 12-18, 1975, 27 elk were observed by residents feeding on a haystack in Section 22 immediately to the west of Highway 93. These elk had descended from the hill separating the homes in the Worden Creek area from the homes in the Valley Grove Subdivision (Section 27).

Occasionally, I found one or two sets of elk tracks in the drainage immediately west of the Valley Grove Subdivision. There is a spring-fed watering trough in this drainage and such tracks led to and from this trough.

Wintering elk in the Bitterroot portion of the study area have not declined to the same extent as those found in the Grave Creek Range area. Most landowners interviewed felt that the elk populations in this area have either remained stable over the past 10 years or have slowly declined in numbers. The elk populations in the West Bitterroots appear to be holding their own on a dwindling amount of habitat at the expense of deer (Burns, Nov. 5, 1973, discussion).

Bitterroot ranchers living immediately to the south of the study area have suffered repeated elk damage to their haystacks for the past 15 to 20 years (Hartkorn and Janson, July 10, 1973, discussion). Such damage was also noted during the winters of 1974 and 1975.

Solitary elk are occasionally seen during the fall and winter by residents of the Mormon Creek Valley. On three occasions I observed elk tracks in the snow along Mormon Creek within one-quarter mile to the west of the area where homes are located. One Mormon Creek resident mentioned that elk were often seen in the area just after hunting season opened. This indicates that perhaps elk descend into Mormon Creek to escape the hunting pressure exerted on them on the Forest Service land at higher elevations (Parker, Jan. 19, 1974, discussion).

Elk are not often seen today across the river in the Sapphire Range portion of the study area. Residents of the Rodeo Ranchette Subdivision area report seeing elk in the open areas behind their homes on only two or three occasions in the past five years. I observed neither elk nor fresh elk sign along Routes 1 and 2.

White-Tailed Deer

White-tailed deer are ubiquitous in the Lolo area as I frequently observed them along all six routes. Most residents interviewed, however, felt that white-tailed deer numbers had declined in recent years, especially in the valley bottom areas west of the Bitterroot River.

Summer and winter range for white-tailed deer in Lolo are not totally separate areas. Generally speaking, however, the forested areas along the creek and river bottoms serve as summer range while the lower slopes of the surrounding mountains were used during the winter.

The Rodeo Ranchettes Subdivision is located in an important white-tail winter range area. One resident recalls counting 98 white-tails on the slope east of the subdivision in 1969 (Johnson, June 19, 1974). Another counted approximately 200 in this same area in 1971 (Steuerwald,

June 19, 1974). During the winter months, I frequently observed white-tails in the wooded draws to the east of the Rodeo Ranchettes (Section 25) and I counted up to 14 on the west-facing slope to the north of this subdivison. During the periods of extreme cold, white-tails were observed utilizing the sunny portions of this west-facing slope as late as midday. During the summer months I also observed white-tails feeding in the alfalfa fields within the Rodeo Ranchettes Subdivision.

During all seasons of the year, I observed white-tails in two relatively undisturbed bottomland areas close to the Rodeo Ranchettes Subdivision. One of these areas was the narrow strip of riparian forest and sloughs in Section 23 to the north of Rodeo Ranchettes. The Bitterroot River forms the western boundary of this region and large portions of undeveloped land lie to the north and to the east. Neither people nor dogs were seen in this area during observation periods along Route 1.

The other area was the matrix of riparian forest, sloughs, and pasture in Section 36 to the south of the Rodeo Ranchettes Subdivision. Except for the fact that no physical barriers lay between this region and the subdivision area, it was as protected from residential development as the undisturbed bottomland area to the north. A dirt road, however, connected the bottomland area to the south with the Rodeo Ranchettes; consequently, people and dogs were frequently seen in this area.

White-tail sightings were more frequent and the numbers seen were usually larger in the bottomland area to the north of the Rodeo Ranchette Subdivision as compared to the bottomland area to the south.

White-tail sightings and sign were more frequent in the patches of riparian forest in the southwest quarter of Section 36 (east of the river)

than in the riparian forest area of approximately the same size in the northwest quarter of Section 36. The latter area bordered the Rodeo Ranchette Subdivision while the former was approximately three-quarters of a mile to the south.

In the Bitterroot bottoms west of the river, white-tails and white-tail pellet groups were not as frequently seen as in the bottomland areas to the east of the river, despite the fact that the west side had more extensive areas of forest and agricultural cover types (Figures 4 and 6). White-tails were more frequently observed in those areas north of the Greenwood Addition Subdivision (Section 26) than in the more developed portions of the Bitterroot bottoms to the south of this area. White-tails and white-tail sign were infrequently seen in the section of riparian forest immediately to the east of the Lake View and Greenwood Subdivision complex (Section 26).

The owner of the northwest quarter of Section 1 reports that three or four deer live on his property during much of the year (McMahan, Sept. 12, 1973, discussion). This landowner also noted that in 1971, 1972, and 1973, a doe gave birth to fawns in the dense cover area of Section 2 to the south of the Lolo Peak Vista Subdivision (Section 35).

White-tails often travel between the upper portions of Lolo Creek into the riparian forest areas along the Bitterroot River (Schroeder, Aug. 23, 1973, discussion). Many deer have been killed by cars where this route crosses the highway in the western half of Section 2 (Schroeder, Aug. 23, 1973, discussion; Maclay, July 7, 1973, discussion).

Gerald Tucker (Mar. 2, 1975, discussion), who farms the northern one-half of Section 3 reports that white-tails in this area have declined

in recent years. A pair of white-tails was often seen in a woodlot near his home during the winter of 1973-74 (Tucker, Mar. 2, 1975, discussion).

In walking Route 5, white-tails were frequently observed in the Mormon Creek area, especially on the open slope to the west of the valley. Judging from the tracks, pellet groups, and sightings, several white-tails winter in this area. Eight white-tails were spotted in January, 1974, in the upper end of the Mormon Creek Valley near the edge of the study area.

White-tails were infrequently seen about the West View Subdivision (south half of Section 27) and most residents felt that the deer numbers in this area had greatly declined in recent years. White-tails and white-tail tracks were commonly seen, however, in the wooded draw and ridge northwest of the Valley Grove Subdivision (north half of Section 27). During the summer months of 1974, I frequently observed white-tails in the large alfalfa field in the west half of Section 22. One doe was killed by a car in this area and another succumbed when she caught her foot in a fence (Michael, Aug. 26, 1974, discussion).

Black Bear

Lolo residents occasionally see black bears within the study area. Sightings are especially common during the fall when bears seek berries among the riparian vegetation. I observed bear scats along routes 2, 3, 5, and 6.

Several recent sightings have been made on the east side of the river where the bears descend from the vast areas of coniferous forest to the east of the study area. A resident of Lolo Peak Vista (Section 35) killed a sow in the southwest quarter of Section 36 (east of the river) in

the summer of 1971 (Wornath, Jan. 9, 1974, discussion). I observed a cub in this area in late August, 1973. A developer of Rodeo Ranchettes (Section 25) reports that he receives frequent bear complaints from the residents of this subdivision (McCullough, Mar. 10, 1975, discussion).

In the Grave Creek Range and Bitterroot Range portions of the study area bear scats were observed on the ridgetops and drainage bottoms. Residents of the upper Mormon Creek area report that they frequently see bears in the fall.

In October, 1974, I observed fresh bear scats along a cattle trail that parallels the west bank of the Bitterroot River immediately to the north of the Greenwood Subdivision (Section 26).

Coyote

Despite the recent boom in residential developments in Lolo, virtually every landowner interviewed felt that coyote populations had not decreased in recent years. Coyote tracks, scats, or sightings were observed on all six routes.

Coyotes appear to be more prevalent on the lower slopes of the Bitterroot Mountains above the Tucker Ranch (northwest quarter of Section 3) and on the slopes above the West View and Valley Grove Subdivisions than elsewhere on the study area. The large number of coyotes on the lower slopes of the Bitterroots is probably related to the presence of sheep raised in this area. Coyote predation on sheep is a chronic problem among sheep ranchers who live just to the south of the study area (Maclay, July 7, 1973, discussion; Schroeder, Aug. 23, 1973, discussion). In January, 1974, three sets of fresh coyote tracks were observed about a calf carcass

on the hill to the west of the Tucker Ranch. Eight coyotes were trapped on this same hill during the winter of 1973-74 (Tucker, Mar. 2, 1975, discussion).

In Mormon Creek, an area immediately over the hill to the north of the Tucker Ranch, coyotes are also commonly noted. Residents of Mormon Creek often hear coyotes howling at night. One early morning in August, 1974, I observed a coyote apparently hunting for mice on the slope to the west of the Mormon Creek Valley.

I frequently observed coyote sign east of the river in the narrow strip of bottomland area in Section 23 but infrequently elsewhere. One coyote was trapped by a resident of the Rodeo Ranchette Subdivision during the winter of 1973-74. Coyote sign was seen on only two occasions on the bottomland routes on the west side of the Bitterroot River.

Tracks, feces and sighting of coyotes were concentrated in the wooded draws in those areas adjacent to the foothill subdivisions. Coyote tracks were frequently observed during the winter months in the drainages that lead into the West View and Valley Grove Subdivisions (Section 27). Often times such tracks were observed to pass through the subdivisions themselves.

Red Fox

Red fox populations have increased in the valleys of Western Montana in recent years (Hoffman et al. 1969). Subdivision land development does not appear to have stemmed this increase in the Lolo area.

Red fox sign and sightings were heaviest in the Bitterroot bottoms as compared to the surrounding hillsides. Foxes were most often seen in

three areas: the southwest quarter of Section 36 along the west side of the river, the perimeters of Plummer's Slough (Sections 23 and 26), and the strip of riparian forest east of the Bitterroot River in Section 23. In addition to these three areas, foxes were seen on two occasions on the hillside above the West View Subdivision (Section 27).

Three residents reported recent red fox predation on their domestic chickens and waterfowl. Five chickens were killed at a residence in the south end of the Rodeo Ranchette Subdivision (Section 25) during the spring and summer of 1974 (Johnson, June 19, 1974, discussion), and a flock of chickens belonging to a rancher who lives in the north half of Section 3 was reduced from 120 to approximately 50 in one year, with much of this attrition blamed on predation by red foxes (Tucker, Mar. 2, 1975, discussion). A retired dairy farmer who lives on the eastern edge of the Lolo Peak Vista Subdivision (Section 35) reports red fox predation on his pet ducks and geese (Wornath, Jan. 9, 1975, discussion).

Two fox dens were located during the course of the study. One den was found in January of 1975 in the riparian-shrub habitat between the Greenwood Subdivision and Plummer's Slough (Section 26). It is suspected that the fox utilizing this den hunted waterfowl that fed and nested in the nearby slough area. A recently-killed domestic duck was found near this site in September, 1974.

A second den was located between two small ponds (gravel pits) in Section 22 east of Highway 93. These ponds were used by three species of migrating ducks in the spring and fall and by molting mallards in the late summer.

A third possible den site was the strip of mixed forest between the Lolo Peak Vista Subdivision and the Bitterroot River. I saw up to four foxes in the vicinity of a small knoll in this area on several mornings when walking route 4. One resident of this area reports seeing two foxes playing with his neighbor's poodle (McMahan, Sept. 12, 1973, discussion).

Beaver

Beaver numbers have declined in recent years within the study area. Two probable causes of this decline are habitat loss and both legal and illegal trapping. Lolo Creek and the Bitterroot River, as well as numerous sloughs in the area, have been utilized by beavers in the past. Within the study area in recent years trapping has occurren in both the Bitterroot River and in some of the adjacent sloughs. I was unable to determine, however, whether beavers are still trapped in Lolo Creek within the boundaries of the study area.

The sloughs and ponds in Section 2 south of Lolo Creek showed the most sign of beaver activity during the course of the study. An active beaver lodge was also found in the northwest corner of Section 2 north of Lolo Creek in the summer of 1974, and a beaver was observed swimming in the river in the southeast corner of Section 33 during the same period. Three inactive beaver lodges were found in the slough in Section 36 east of the river and apparently all the beavers had been trapped out of this area.

Doyle's Slough contained several beavers prior to subdivision (Hayden, Sept. 13, 1973, discussion). With the development of the Lake View and Greenwood Subdivisions, however, much of the vegetation around Doyle's Slough was destroyed, including the alders, cottonwoods, and

willows utilized by beavers. No beavers or fresh beaver sign were observed in Doyle's Slough during the course of the study.

Ring-necked Pheasants

Pheasants have declined in numbers on the study area in recent years as they have in the entire Bitterroot Valley (Janson, Sept. 26, 1974, discussion; Burns, Nov. 5, 1973, discussion). Pheasants prefer agricultural areas and high pheasant numbers often occur where grain fields are interspersed with forbs, shrubs and cattail cover. Lolo had many acres of such habitat in 1937 (Figure 4). Observation of the 1964 and 1972 aerial photographs, however, shows a decrease in the number of grain fields in the study area as well as considerable drainage and filling of the wet areas in Sections 2, 26, and 35. Predation by the domestic dog and cat has probably contributed to the demise of the pheasant in the Lolo vicinity, since homesites have been situated within their historical habitats.

In the 1930s and 1940s it was reportedly common to be able to shoot one's limit of pheasants within one or two hours in several parts of the study area. One area in particular was the perimeters of the cornfield in the southeast quarter of Section 26. The site of this cornfield is now a portion of the Lake View Subdivision.

Only three pheasant sightings and six crowings were heard during the course of the study; all were in the Bitterroot Valley bottoms. Two sightings, both hens, and two crowings were made along an irrigation ditch in Section 26 immediately to the west of the Greenwood and West View Subdivisions. Four crowings and the other sighting were noted in wet meadow and irrigated pasture cover types in Section 2 south of Lolo Creek.

In addition to these pheasant observations, local landowners' report recent pheasant sightings in the grain and hay fields at the base of the Bitterroot Range in Sections 2 and 3, and along Lolo Creek in Section 34. A brood of pheasants was also reportedly raised near a farmstead in the northeast quarter of Section 35 during the spring of 1973 (Murphy, Oct. 7, 1973, discussion).

Ducks

Ducks observed within the study area include: mallard, blue-winged teal (Anas discors), cinnamon teal (Anas cyanopteras), wood ducks (Aix sponsa), pintails (Anas cyanopteras), widgeons (Mareca americana), buffleheads (Bucephala albeola), common mergansers (Mergus merganser), and hooded mergansers (Lophodytes cucullatus). Duck populations were highest during the spring and fall migration periods. I observed broods of mallard, blue-winged teal and cinnamon teal, indicating that these species nested within the study area. Mallards also wintered on the study area.

Most residents interviewed felt that duck populations had decreased in recent years, especially along Lolo Creek and in the marshy areas in Sections 23 and 26 west of the river. I frequently observed ducks in the sloughs east of the Bitterroot River.

Subdivisions platted within historical duck habitat included: Mulhauser (Section 22), Lolo Peak Vista (Section 35), Lake View (Section 26), and Greenwood (Section 26). Tables 6 and 7 show that prior to land disturbance these four areas contained 61 acres of wet meadow and 7 acres of marsh-slough. Furthermore, each of these subdivisions is located within or adjacent to larger acreages of wet area (Figures 4 and 6).

There are other important factors affecting duck habitat in the Lolo area besides subdivision development. Drainage of the marsh-slough and wet meadow cover types in Sections 2 and 26 (Figure 4) dried up open water areas and many acres of aquatic vegetation, thus destroying duck habitat. At the base of the Bitterroots in Section 2, however, open water and aquatic vegetation were maintained by the flow of excess irrigation water from the hillside above.

Ducks were most often found in wet areas that were separated from sites of residential development by either distance or by physical barriers such as the Bitterroot River and steep cliffs. On the east side of the river major areas of duck concentration were the sloughs at the base of the Sapphires in Sections 22, 23 and 26. Each of these areas was an old river channel that contained standing water year-round. Each became an active side channel of the Bitterroot River during the runoff period in June of 1973 and 1974.

The slough area in Section 36 east of the river was utilized by ducks and other waterfowl during all seasons of the year. Up to 38 mallards were observed utilizing this area during the winter of 1973-74. In fall this area was frequently hunted by both the landowner and his guests, and by trespassers.

The slough areas of Sections 22 and 23 east of the river attracted the richest collection of ducks observed anywhere on the study area. During the spring migration of 1974 this area was utilized by mallards, pintails, widgeons, wood ducks, common mergansers, and hooded mergansers. These sloughs were also used by molting mallards during the summer of 1974.

Major areas of duck concentration west of the river were Plummer's Slough (Sections 23 and 26) and the wet areas in Section 2 south of Lolo Creek. In fall, 1974, I jumped 18 mallards in an irrigation ditch west of the Mormon Creek Valley in the northwest quarter of Section 4. Two broods of blue-winged teal and one brood of mallards were observed in the areas of potholes and sloughs in Section 2 south of Lolo Creek during the summer of 1974.

Small groups of ducks (including bufflehead) were also observed on the Bitterroot River, especially during the migration periods. These "river ducks" were often seen in those sections of the river adjacent to the Rodeo Ranchette (Section 25) and Greenwood Subdivisions (Section 26) as well as in the more secluded sections of the river.

Doyle's Slough was important waterfowl habitat prior to land development. With subdivision platting, however, destruction of much of this habitat occurred because of dredging. Few ducks were observed on Doyle's Slough during the study. Snow geese (Chen hyperborea) and whistling swans (Olor columbianus) also used Plummer's Slough and Doyle's Slough in previous years, but neither was observed in these areas during the course of my study (Hayden, Sept. 13, 1973, discussion; Miller, Sept. 25, 1974, discussion).

Two Lolo residents attracted ducks to their ponds by providing grain; another resident observed the successful raising of a blue-winged teal brood in a small slough adjacent to her home.

Canada Geese

Canada geese were observed along the Bitterroot River during all seasons of the year. The addition of migrant geese during the spring and

fall months caused the observed population to peak at between 40 and 60 birds. The estimated resident population was between 15 and 20 geese. Geese were reported to successfully nest on the study area in recent years (McMahan, Sept. 12, 1973, discussion), but none were observed during the spring of 1974.

Geese were frequently seen on the river and sandbars adjacent to the Rodeo Ranchette Subdivision (Section 25). A few geese observed in this area appeared somewhat habituated to people, as they would allow one to approach within 75 feet before flying. Geese were also commonly seen in Plummer's Slough and in the sloughs and sandbars in Sections 22 and 23 east of the river.

Moose

Moose historically frequented the riparian habitats in the study area but there have been few sightings in the past 20 years. During the mid-1950s a moose was observed along Lolo Creek in Sections 1 and 2, and one was seen with a calf (McMahan, Sept. 12, 1973, discussion). In 1960 a moose was seen in the Mormon Creek Valley (Laing, Mar. 7, 1975, discussion). A moose was also observed in 1971 in the northwest quarter of Section 36, east of the river (Johnson, June 19, 1974, discussion).

Striped Skunk

Skunk or skunk sign (tracks, odor) were encountered in both the Bitterroot Valley and in the Bitterroot foothills portions of the study area. Two residents reported skunk predation on domestic duck eggs and another on chicken eggs. Skunks may possibly have increased with subdivision development due to the presence of additional food sources.

Muskrats

Muskrats were observed in the sloughs throughout the Bitterroot Valley as well as in the Bitterroot River. Doyle's Slough was historically good muskrat habitat but with subdivision much of this habitat was destroyed. One Lolo resident reported that muskrats created holes in the banks of his fishponds (Wornath, Jan. 9, 1974, discussion). Eleven muskrats were trapped in Doyle's Slough in 1972 (McHatton, Jan. 24, 1974, discussion).

Red-Tailed Hawk

A pair of red-tailed hawks nested in the top of a Douglas fir in the southeast quarter of Section 1 during the summer of 1974. A pair of red-tailed hawks was also frequently seen in the coniferous forest area to the northwest of the West View Subdivision (Section 27), but a nest site was never discovered. Red-tailed hawks were sighted in no other portions of the study area.

Bald Eagle

On three occasions I observed a pair of bald eagles flying above the Bitterroot River (Sections 23 and 25) during the winter of 1973-74. Two residents of Rodeo Ranchettes (Section 25) reported that they frequently saw a pair of eagles roost in the tall cottonwoods directly across the river from the subdivision (Steuerwald, June 19, 1974, discussion; Johnson, June 19, 1974, discussion). It is probable that these eagles came into the Lolo area from the surrounding mountains to feed on fish. A Lolo resident who lived in the southwest quarter of Section 23 reported that in past years, bald eagles had harassed nesting geese in this area (Michael, Aug. 26, 1974, discussion).

Common Crow and Black-Billed Magpie

Crows and magpies were both abundant and conspicuous in the developed as well as the non-developed portions of the study area. During the winter months both species were frequently observed feeding on carrion. Magpies nested in hawthron bushes throughout the study area, often choosing locations on the perimeter or within the boundaries of residential subdivisions. Magpie populations appeared to peak in the Lolo area during the winter months.

Hungarian Partridge and Ruffed Grouse

Hungarian partridges were released in the Lolo portion of the Bitterroot Valley in the early 1930s (Hughes, Mar. 2, 1975, discussion; Vic Miller, Sept. 25, 1974, discussion).[22] The total population of these birds was low in the Lolo area prior to the recent boom in subdivision development as well as during the period of this study. I located two coveys of Hungarian partridges within the study area. One was on the hill immediately to the west of the West View Subdivision (south half of Section 27); the other was on the lower slopes of the Bitterroot Mountains in Section 3. These two coveys contained approximately 9 birds and 14 birds respectively.

Ruffed grouse populations have also been very low within the study area in recent years. On only five occasions did I see ruffed grouse during the course of the study, twice in the section of riparian forest paralleling the river in Sections 26 and 35, twice in the Mormon Creek drainage, and once in the coniferous forest cover type east of the river.

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[22] Mussehl and Howell (1969) stated that the Hungarian partridge were planted throughout the State of Montana between 1922 and 1926.

Residents of Mormon Creek reported that they occasionally see grouse in riparian and coniferous forest habitats about Mormon Creek during the summer months.

Great Blue Herons

Great Blue Herons were found in wet areas throughout the study area and were observed feeding in the sloughs that lie on the perimeters of the Greenwood (Section 26), Lake View (Section 26), Mulhauser (Section 22), and Lolo Peak Vista (Section 35) Subdivisions. Herons were also frequently seen along the Bitterroot River. Two residents reported seeing Great Blue Herons prey on fish in their fish ponds. At least two herons overwintered within the study area during 1974-75.

Lewis' Woodpecker

Large numbers of Lewis' woodpeckers summered in the strip of riparian forest that parallels the Bitterroot River. In addition to nesting in cottonwood and other trees (usually dead snags), the Lewis' woodpecker was also observed to nest in teletphone poles within both the Rodeo Ranchette and Lake View Subdivisions.

Effect of Dogs on Wildlife

Several Lolo landowners reported incidences of dogs harassing white-tailed deer and other wildlife prior to the recent subdivision boom. Dogs were observed pursuing deer in the Andrew's Gulch area (Section 28) as early as the mid-1940s (Tucker, Mar. 2, 1975, discussion) and dogs were observed chasing deer in the Mormon Creek drainage in the winter of 1958-59 (Tucker, Mar. 2, 1975, discussion). Dogs disrupted pheasant nests in the

southeast corner of Section 26 prior to the development of the Lake View Subdivision (Rossignol, Oct. 19, 1973, discussion).

Three landowners also reported past instances of dogs chasing cattle or sheep. In one instance three dogs were shot after cornering a bunch of calves (Rossignol, Oct. 19, 1973, discussion).

During the course of the study I frequently saw free-roaming dogs about the West View (Section 27), Vann Ostrand (Section 34), and Lolo Peak Vista (Section 35) Subdivisions. During the winter of 1972-73, dog tracks were often seen in the snow above the West View Subdivision, and on one occasion a large German shepherd was observed in the coniferous forest area to the north of West View. In January, 1974, two dogs were observed feeding on a calf carcass in the northwest quarter of Section 3 and were followed back to the Vann Ostrand Subdivision. On four occasions, dogs were observed in the riparian habitat immediately to the south of the Lolo Peak Vista Subdivision. In February, 1972, barking was heard for about an hour in the coniferous forest west of the Mormon Creek Subdivision (Section 33) and it sounded as if a pursuit was occurring.

Dogs from the Lolo Peak Vista Subdivision have been observed swimming the Bitterroot River in order to chase white-tails in the range and forested areas east of the river (Murphy, Oct. 7, 1973, discussion). Dogs from the Lolo Peak Vista Subdivision also reportedly killed two white-tails in Section 1 east of the river during the spring of 1973 (McMahan, Sept. 12, 1973, discussion). Subsequent investigation of this area in the fall of 1973 led to the discovery of one white-tail carcass.

In February, 1974, I observed a dog digging up muskrat houses in the southwest quarter of Section 36 west of the river. Access to these houses was available because the pond was frozen.

Jim Debore, a warden for the Montana Fish and Game Department (who happened also to reside in Lolo) reported that he receives frequent dog complaints from Lolo residents (June 6, 1975, discussion). Incidences of dogs chasing deer are especially common in the riparian forest area between the Lake View-Greenwood complex and the Bitterroot River. A doe was killed in this area during the summer of 1974 (Debore, June 6, 1975, discussion).

Field observation showed that most Lolo residents kept their dogs penned when they are not out with them. I estimate that a maximum of 15 dogs roamed free of the subdivision areas during the day, as I would often encounter the same dogs in the field. The number of dogs roaming free at night is unknown. Debore (June 6, 1975, discussion) felt that most deer kills by dogs in the Lolo area were made early in the morning.

Human Usage of Areas Adjacent to Subdivisions

Access by recreationists to the private lands adjacent to Lolo subdivisions was gained from both outside and within the study area. The forested lands surrounding Lolo are owned by the U.S. Forest Service, the State of Montana, Burlington Northern Railroad, large private landowners, and a few small private landowners. Access to private lands on the hillsides above the Bitterroot and Lolo Creek Valleys is often gained by using Forest Service roads and then crossing fences to get onto privately owned lands. In many instances such acts represent trespass since the owner's permission to be on such lands was not acquired.

Residents, especially children, from subdivisions within the study area were also frequently observed on the private land surrounding these subdivisions. Such occurrences were especially common about the West View Subdivision (Section 27), and in the fields and forested areas along the western bank of the Bitterroot River.

People utilized the lands surrounding Lolo area subdivisions for many activities. West of the West View Subdivision (Section 27), trail bikes and snowmobiles were frequently observed traveling from the subdivisions onto private land. Trail bikes were also observed in the small portions of valley bottom in Sections 25 and 36, east of the river.

In the fall, the slough area in Section 36 east of the river was hunted for waterfowl by both the landowner and his guests, and by trespassers. On three occasions, archery hunters were observed hunting for deer in the riparian forest areas adjoining the Lolo Peak Vista (Section 35), Larson's Lolo Tracts (Section 35), and Greenwood (Section 26) Subdivisions.

The Bitterroot River was the source of considerable recreational use, especially during the summer months. On four occasions, fishermen were observed walking along the bank of the river north of the Greenwood Subdivision. During the summer of 1974, a motorboat was observed on the section of the river adjoining the Greenwood Subdivision. This was an area in which geese were also frequently seen.

I frequently observed rafts and canoes on the Bitterroot River during the spring and summer months. One stream bank resident reported counting up to 20 rafts and canoes in a single day during the summer of 1972 (McMahan, Sept. 12, 1973, discussion). Geese and duck broods scatter

when a canoe or raft comes upon them, but it is not known how permanent the results of such harassment may be.

Children from Lolo Peak Vista (Section 35) and other subdivisions were frequently observed playing and swimming in Lolo Creek during the summer months. They were also observed in the northern portions of Section 2 south of Lolo Creek during this same period, but on only one occasion.

Local landowners reported increasing trespass problems in the past few years. Among the specific trespass complaints regarding the residents of the study area subdivisions were the following: harassment and in one instance the shooting of sheep and cattle (Wornath, Jan. 9, 1974, discussion), increased requests for hunting and access privileges, disruption of haystacks, illegal hunting, and predation of wildlife by dogs and cats belonging to subdivision residents.

CHAPTER VI

DISCUSSION

Problems in the Analysis

On the whole, species diversity and, for many species, population sizes were already declining before the subdivision boom began in Lolo in the mid-1960s. This fact, together with a lack of quantified pre-subdivision wildlife data, complicate the task of separating out the specific effects of residential land development on wildlife and wildlife habitat.

In addition to a tremendous increase in the number of acres devoted to residential use in the past 46 years, other important land use changes have also occurred in the Lolo area. Two of the most important changes are a decrease in agricultural diversity and an increase in the recreational use of the Lolo area by non-Lolo residents.

The intensification of agricultural land use such as has occurred in Lolo has a negative impact on the habitat of many species, especially the habitats of upland game birds (Swanson and Yocum 1958, Warbach 1958, Schumacher 1969). In recent years, the emphasis on hay and beef cattle production has reduced the edge effect of mixed farming that is conducive to maintaining large, diverse wildlife populations (Caslick 1972). This trend away from agricultural heterogeneity occurred prior to as well as during the period of rapid residential development.

The habitats of Hungarian partridges and ring-necked pheasants are closely tied to agricultural communities and the decrease in the population sizes of these two species within the study area appears to be more the

result of the agricultural changes that have occurred than the result of habitat loss to residential developments. Swanson and Yocum (1958) point out that food and cover for these two species decline with such agricultural practices as field consolidation, elimination of fence rows, less edge effect, and the eradication of brushy areas within farm boundaries; all of these have occurred in Lolo as agricultural land use has intensified. Other species such as the crow and black-billed magpie appear to be less affected by such land use changes and may even increase in numbers.

When the boom in Lolo subdevelopment began in 1964, Lolo had already experienced a significant increase in the number of recreationists utilizing the lands both within and adjacent to the study area. Lolo subdivisions were platted in a region already experiencing the many effects of increased human inhabitation. The city of Missoula, upper Miller Creek, and other parts of the Lolo and Bitterroot Valleys were being developed both before and during the Lolo subdivision boom. Lolo's development merely added to the general population growth in this region of Western Montana.

During the 1950s and 1960s many new logging roads were built on the National Forest lands adjacent to the study area. These roading systems are particularly dense on the public lands in upper Mormon Creek and in the portions of the Graves Creek Range adjacent to the study area. Such roads vastly improved hunter and other recreationist access into these areas and into my study area.

The ever-present factor of grazing also complicates the task of looking solely at the effects of Lolo subdivisions. Horses, cattle, and sheep were grazed in the study area and competition with wild ungulates was certainly occurring in those portions of the Sapphire Range (Section 23)

and the Bitterroot Range (Section 3) that were badly overgrazed. In addition to such rangeland areas, much of the riparian understory in Sections 26 and 35 (west of the river) was also heavily grazed before and during this study.

Other man-related influences on the wildlife in the Lolo area include such factors as increased hunting pressure on the public and private lands surrounding the study area, the prior and continual use of agricultural pesticides and herbicides, and the prior use of Compound 1080 in coyote control (Guffey, Jan. 20, 1975, discussion).

There is a need for future studies in which pre-development baseline data are collected on species diversity, population sizes, and habitat utilization. Following the establishment of such pre-subdivision baselines, data on species diversity, habitat utilization and population sizes should again be collected both during and after the period of development in order to measure the changes in these parameters. Such a study would need to be considerably longer than two years, since subdivision development in rural areas often occurs over a number of years and the available lot sites are slowly developed.

I would also suggest limiting the number of animals studied to one or two species or to a group of related species. Geis (1973) and Warbach (1958), for example, looked largely at passerine birds in their studies of population dynamics in relation to land use changes. An intensive study of the relationship of white-tailed deer to land development in Western Montana, for example, would provide valuable information to land use planners, biologists, and others. Such white-tail habitats as riparian forests and other bottomlands are receiving heavy subdivision pressures,

thus making this species particularly vulnerable to habitat deterioration.

One problem with the methods employed in this study was the emphasis on field observation and landowner interviews. Such data point out trends in habitat use and population size changes for many species. I feel, however, that sole reliance on these methods gives results that have a tendency to be biased in favor of the more noticeable species. The "route method" utilized showed the relative degree of habitat use for different portions of the study area but gives incomplete population data as many of the species studied were either partially or entirely nocturnal in character. Also, during the winter months, a greater amount of habitat use data was collected than during the other seasons, as animal movements and numbers were discernable from fresh tracks left in the snow as well as from droppings and sightings.

Biotelemetric methods would be a useful tool in a study of wildlife habitat use about residential developments. The daily and seasonal movements of a species such as the white-tailed deer or red fox could be regularly plotted on a topographic map. Such data could be collected at night as well as during the day. Biotelemetric methods would allow the investigator to accurately measure the distances from residential areas that the radio-collared individuals frequent and also the degree of use made of the available habitats in such areas.

Wildlife-Cover Relationships

Cover, to a greater extent than food or water, is the habitat requirement that has been the most jeopardized as a result of subdivision

activity in the Lolo area. Prior to the period of recent subdevelopment (1957-1971), the Lolo area was a matrix of dense vegetation (cattail marsh, forests, shrubby draws, etc.), open areas (agricultural and range land cover types) and water (sloughs, rivers, and creeks). Within the matrix were strips of roads, an occasional farmstead, and one small centrally located area of homes and commercial establishments. Principal wildlife cover areas were the strip of riparian forest along Lolo Creek and the Bitterroot River, fingers of coniferous forest within the rangeland, and the many acres of cattail marsh and wet meadow in the valley bottoms. Agricultural land provided strips and patches of cover in the form of fence rows, hay meadows, and occasional grain fields. Interspersion among cover types was high (Figure 4), as feeding areas such as sloughs, rangeland, and agricultural fields were often linked by areas of dense cover.

Between 1951 and 1973, 629 acres of this matrix were divided and converted to residential plots. Among the cover types lost to such subdivisions were 190 acres of forests, 68 acres of marshes, sloughs and wet meadows, and 251 acres of agricultural land.[23] These cover areas were formerly utilized by a great variety of wildlife and satisfied such cover requirements as shelter, nesting and fawning sites, travel lanes and sanctuary.

In addition to this platted subdivision acreage, 591 additional acres were divided into parcels less than 20 acres in size during the same period. Many of these small unplatted parcels were utilized as homesites and were located within important cover areas (Figures 4 and 6).

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[23]The 14 acres of irrigated pasture and 12 acres of deciduous forest replaced by the Delaney Subdivision are not included in these totals.

Table 8 gives a partial breakdown of species utilization of the various cover areas in the Lolo vicinity.

Table 8. Cover areas for selected wildlife species

Cover Type	Species
Agricultural land (excluding farmsteads)	red fox, striped skunk, ring-necked pheasant, Hungarian partridge
Deciduous and mixed forest	white-tailed deer, black bear, coyote, red fox, great blue heron, red-tailed hawk
Coniferous forest	elk, white-tailed deer, black bear, coyote, red-tailed hawk
Marshes and sloughs	beaver, muskrat, ring-necked pheasant, ducks, geese, great blue heron
Wet meadows	ring-necked pheasant, great blue heron

More important than the small percent of the study area land base utilized for residential purposes is the location of such areas. Many subdivisions tend to break up the continuity of large areas of cover and to reduce the total acreage. This lowers the cover qualities of such areas. The Valley Grove Subdivision, for example, is located within a strip of coniferous forest that bisects the rangeland on the lower slopes of the Grave Creek Range, while five subdivisions interrupt strips of coniferous forest along water courses (Figures 4 and 6). Such subdivisions bisect strips of cover important to white-tailed deer, black bear, and coyote.

The Lolo Peak Vista and Lake View Subdivisions together replaced 62 acres of marsh and wet meadow, thus breaking up the available cover for ducks, herons, muskrats, and other species. Ten separate subdivisions were platted at least partially on agricultural land, land that formerly

provided cover for the already declining populations of pheasants and Hungarian partridges.

When a subdivision breaks up the continuity of a cover type or substantially diminishes its size, many species utilizing these areas are subject to greater harassment by people and their pets; thus, the usefulness of such areas as escape cover or sanctuary is diminished.[24] Generally speaking, the larger an area of cover, the more frequently it was used by those species whose cover requirements it satisfied. The most heavily used cover areas, however, appeared to be those regions separated from residential areas by either distance or physical barriers. Such areas not only supported larger numbers of animals but the diversity of species found there also tended to be higher.

The strip of riparian forest, sloughs and sandbar in Sections 22 and 23 east of the river serve as an excellent example of a sanctuary area. Although located within one-half mile of three large subdivisions, this particular region was isolated from residential developments by natural physical barriers. Species diversity and abundance was high in this area. The species observed here included white-tailed deer, coyotes, red foxes, striped skunks, great blue herons, Lewis' woodpeckers, black-billed magpies, Canada geese, and seven species of ducks. Hooded mergansers, furthermore, were observed in no other part of the study area and the populations of

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[24] Whenever the word "species" is referred to in this discussion, it shall mean those 28 birds and mammals mentioned in the "Results" section, pages 62-79. Sanctuary areas are those cover areas where an animal can seek shelter or hide and be free from harassment.

white-tailed deer, Canada geese, Lewis' woodpeckers, widgeon, wood ducks, and common mergansers were among the highest observed during the study.

An area of cover, composed of riparian forest, marsh-slough, and wet meadow, was located approximately one-fourth mile to the south of the Rodeo Ranchette Subdivision (Section 25). Except for a dirt road connecting this region with Rodeo Ranchettes, it was as protected from residential development as was the previously described sanctuary area to the north of the same subdivision. Species diversity was considerably lower here, however, and only the observed mallard, pintail and great blue heron populations were as large as the population of these species utilizing the sanctuary area to the north.

The reason for the contrast in both species numbers and diversity between these two regions appears to be the differences in access to the Rodeo Ranchette Subdivision and, to a lesser extent, the differences in distance from the subdivision area. Hunters, children and dogs were observed in the area south of the subdivision; none were observed to the north. Similarly, beavers, coyotes, and red foxes have recently been trapped in the southern area but not in the sanctuary to the north.

White-tailed deer utilized the patch of riparian forest in the southwest quarter of Section 36 (east of the river) more often than they did the patch of riparian forest of approximately the same size on the northwest quarter of Section 36 (Figures 4 and 6). The reason appears to be that the former area is located a greater distance from the Rodeo Ranchette Subdivision and hence deer utilizing this area are less subject to such harassments as free roaming dogs and human recreational use.

Similar differences in species numbers and species diversity were noted among cover areas located in the Bitterroot Valley to the west of the river. Cover areas had few natural barriers to separate them from residential developments and distance from such developments appeared to be the most important consideration in determining the degree of use of a particular area.

The frequency of white-tailed deer, mallard and muskrat sightings was considerably higher in those cover areas northwest of the Lake View-Greenwood complex (Section 26) than in the strip of riparian forest immediately to the west and east of this large residential area. Similarly, Plummer's Slough and the slough areas in the northern part of Section 22 were utilized to a greater extent by mallards and other ducks than was the slough bordering the Lake View and Greenwood Subdivisions.

Other cover areas utilized as sanctuary are the coniferous forests that begin on the eastern and western perimeters of the study area, and the marshes, sloughs and wet meadows in Section 2 south of Lolo Creek. The latter of these two areas consists of a series of small openings separated by erect and fallen trees, thick groves of alder, willow and river birch, pockets of standing water, and numerous sloughs (Figure 4). Although less than one-fourth mile from the Lolo Peak Vista Subdivision (Section 35), this region functioned as a brood area for ducks and a fawning site for white-tailed deer. Only infrequently did I observe other people or dogs in this area, as the combination of thick brush and water areas (Figure 4) made it difficult to penetrate.

Many sanctuary areas are diminishing in size as a result of land development. There are also fewer sanctuary areas today than before the

recent boom in subdevelopment. In many cases,although the cover making up former sanctuary areas remains, the isolated or protected qualities of such areas are now destroyed. These areas are no longer satisfactory sanctuaries for such species as white-tailed deer and wild ducks; hence, the degree of use has declined.

Riparian forest, backwater areas, hay meadows, and marshland all occur in large acreages west of the river (Figure 4). Yet, more abundant populations of geese, ducks, and white-tailed deer are found in such bottomland areas east of the river. Three related reasons for this observation are: (1) land ownership parcels are larger and tend to be more intact on the east side (Figure 6), (2) residential development is located in only one area on the east side (Section 25) while they are located in numerous areas on the west side (Sections 26, 27, and 35) (Figure 6), and (3) human and pet populations were considerably lower on the east side because of the low housing density and more restricted access.

On the hillsides next to the three foothill subdivisions elk and white-tailed deer utilized the strips of coniferous forest as travel corridors (Gill and Bonnet 1973) as well as sanctuary areas. White-tailed deer, for example, fed in the alfalfa fields located at the base of the mountains in Section 22, and also within the Rodeo Ranchette Subdivision (Section 25). Elk occasionally fed on range grasses in Sections 21 and 22 and on haystacks in Section 22. During such feeding periods both species passed through or very close to housing developments. Tracks, feces, and in the case of white-tails, sightings, were found, however, to be concentrated in the wooded draws close to such subdivisions. This indicates that deer and elk used such draws as travel corridors between low elevation

feeding sites adjacent to the residential areas and the vast coniferous forest areas at higher altitudes.

The density of homesites largely determines the amount of food, water, and cover remaining within residential developments, and this affected the ability of many wildlife species to utilize such areas. Many gradations of development intensity exist in the Lolo area (Figure 6). A comparison of the upper Mormon Creek area (with three homes in the valley proper) to the more densely settled Lake View and Hughes Subdivisions (with up to four homes per acre) serves as a good case in point, as they represent the two extremes of residential housing density.

It should be pointed out that although the upper Mormon Creek area is now primarily residential in use, the acreage sixes of the three Mormon Creek ownership parcels within the study area are approximately 9, 25, and 97 acres. The upper Mormon Creek area is not a platted subdivision composed of numerous small lots but instead represents the division of a former agricultural area among three new owners (Figures 4, 5, and 6).

White-tailed deer and ruffed grouse are frequently seen within the Mormon Creek Valley as well as in the non-developed range and forested regions surrounding this area. In addition, elk and black bear also are occasionally seen within the valley during the late summer to winter period. Wildlife use of the Mormon Creek area may have increased as a result of the greater amount of food and water available, resulting from the change in land use. Two of the new owners have built fish ponds and report that great blue herons have subsequently been attracted to the valley. Also, the valley floor, once heavily grazed, now contains lush alfalfa and lightly grazed pastures.

Comparatively little food, water and cover remained within the confines of the Lake View (Section 26) and Hughes developments (Section 35) following home construction. Home sites are so dense that there is virtually no habitat remaining for such species as white-tailed deer, pheasants, muskrats and wild ducks. However, these species still exist in small numbers in the undeveloped lands adjacent to these subdivisions. The relationship of habitat to housing density found in comparing upper Mormon Creek with the Lake View and Hughes developments agrees with the findings of Gerstung (1970) and Caslick (1972).

Wildlife Adaptation to Subdivision Land Development

Considerable differences in the ability to live in close proximity to rural residential areas were found among the species considered in this study. With the exception of the medium-sized carnivores (Gill and Bonnet 1973), the avian species living in the Lolo area displayed a greater ability to adapt to habitat changes caused by land development than did terrestrial animals. Such differential abilities to adapt have also been discussed by Larson (1972), Figley and Vanduff (1973), and Howard (1973).

The populations of coyotes, red foxes, striped skunks, crows, black-billed magpies, and Lewis' woodpeckers have all remained about the same or have increased in number during the period of subdevelopment, while those of white-tailed deer, beavers, muskrats, mallards, blue-winged teal, and cinnamon teal appear to have declined. It should be restated that the population fluctuations for each of these species were also affected by other land use changes in the Lolo area in addition to subdivision development. However, sufficient historical information and field observations

led me to believe that such populations were affected by subdivisions in the manners just specified.

Moose, Hungarian partridge, and pheasant populations were already declining prior to the platting of the first recent Lolo subdivision in 1957. The declines in the populations of these species, however, appear to have been accelerated as a result of the additional habitat deterioration caused by residential land developments.

Insufficient information was found to determine whether subdivision development in the study area depressed the populations of black bears, bald eagles, Canada geese, red-tailed hawks, great blue herons and ruffed grouse. Great blue herons and ruffed grouse habitats were considerably reduced in total acreage by subdevelopments, however, which indicates that perhaps the carrying capacity for these species was lowered. Both species suffered the loss of feeding areas and potential roosting sites. Each species was observed in the riparian forest areas on the edges of subdivision; yet, the heron populations in such areas were considerably larger, indicating that perhaps ruffed grouse were more susceptible to predation by dogs and cats.

Two hundred and thirty-eight acres of elk winter range were developed into residential subdivisions by the summer of 1973. These 238 acres have been lost and will likely never be regained as winter habitat for elk.

Elk usage of the winter range immediately adjacent to these subdivided winter range areas has declined in the past 10 years. Such a drop in usage, however, is felt to be caused largely by increased hunting and recreational pressures brought about by improved access to land outside

the study area and by other residential developments within winter range areas near Lolo.

The group of elk still utilizing the rangelands adjacent to the West View and Valley Grove Subdivisions (Section 27) were more frequently observed during periods of winter stress. During such intervals elk were observed within one-half mile of these subdivisions. Apparently deep snow or extremely cold weather forced these elk to seek the food (haystacks, exposed grasses) and less extreme thermal conditions found close to these two housing developments.

Those species that have tolerated residential encroachments into their habitats are sometimes considered pests by the subdivision residents. Coyotes, foxes, and skunks were considered by many as undesirable because of their tendency to prey on sheep, poultry, ducks (domestic and wild) and birds' eggs.

Red foxes denned on the peripheries of the subdivided areas where adequate escape cover was present, while coyotes appeared to enter subdivided areas using corridors of undeveloped land in the manner described by Gill (Gill and Bonnet 1973).

Muskrats and great blue herons were sometimes considered undesirable when they utilized fish ponds within the subdivisions. Muskrats undermined the banks and levees around such ponds, while herons were observed feeding on the planted fish. Such fish ponds were located on the periphery of low-density subdivision areas where access to escape cover was readily available.

Ducks suffered considerable habitat destruction in the Lolo area because of wetland drainage and the dredging or filling of slough areas.

Mallards, however, at least partially compensated for such habitat reductions by utilizing isolated irrigation ditches and water-filled gravel pits as sanctuary areas. Similarly, the Lewis' woodpecker compensated for the loss of tall cottonwood snags in the Bitterroot Valley riparian forests by nesting in subdivision area telephone poles.

Wildlife Habitat Loss Continues

Land subdivision in Lolo has greatly accelerated in recent years; yet in 1973, platted subdivisions amounted to only 6.7 percent of the study area while the total acreage divided into parcels smaller than 20 acres represented only 12.9 percent. From the standpoint of total land area, the study area is still dominated by agricultural and rangeland uses. The 13 subdivisions and other densely populated residential areas, however, appear to have an affect that extends far beyond the outer edges of the residential boundaries.

Despite trespass laws, barbed wire fences, and sometimes hostile landowners, increasing numbers of recreationists, children, and free-roaming dogs are now found on the lands adjacent to land developments. In those areas not protected by natural barriers, harassment of such species as the white-tailed deer, pheasants, muskrats, beavers, and ducks has increased. The available habitat for these species is already in less than optimum condition as a result of the loss of habitat due to land development. With more people and dogs moving through these areas, the remaining habitat is made even less desirable as potential escape cover, travel lanes, or as fawning and nesting sites.

Incidences of dogs chasing, killing, or otherwise harassing wildlife were observed in Lolo prior to the recent period of rapid subdivision

development. As the Lolo population has grown, however, so have the incidences of such harassment. The species most often mentioned as being the prey of dogs in Lolo are white-tailed deer, and to a lesser extent ducks, pheasants, and muskrats.

The continual presence of free-roaming dogs such as those found around many Lolo residential areas may permanently displace portions of the local deer population from their home range. This raises the chance of deer deaths due to natural as well as unnatural causes because deer are being forced to inhabit unfamiliar territory. It is important to note that in the deer-dog relationship studies of Perry et al. (1971) and Corbett et al. (1971); their research was conducted in areas where the habitat of deer was not being seriously degraded other than by free-roaming dogs. In the Lolo area, however, many subdivisions are located within white-tail summer and winter ranges. The deer formerly inhabiting these ranges are at least partially displaced to adjacent and often higher elevations of marginal habitat.

Habitat deterioration in the Lolo area and the resultant decline in many wildlife populations will continue as the Lolo population grows.[25] Another subdivision was platted in 1974 that will place homes on the stretch of rangeland forming the western boundary of the Mormon Creek Valley. Also, new subdivisions are proposed for the east side of Doyle's Slough and on the mountainside adjoining the western edge of the West View Subdivision (Section 27). These new subdivisions will shrink the already limited cover

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[25]The Missoula Planning Board estimated the Lolo area population will reach 7,000 by 1990 (revised estimate given by the Planning Board at a Lolo town meeting, September 23, 1973). The estimated population of Lolo in 1973 was approximately 2,000 (Missoula Planning Board 1973).

and sanctuary areas to an even greater extent, and will further break up the continuity of travel corridors and the interspersion between the various cover types.

Unless subdevelopment is stopped or considerably abated within the Lolo area, the populations of elk, white-tailed deer and wild ducks will continue to decrease. Even the more tolerant species such as great blue herons, red foxes, and coyotes will also begin to decline as Lolo becomes more urbanized and the remaining habitats for these species become so deteriorated that such species are forced to live elsewhere.

CHAPTER VII

MANAGEMENT SUGGESTIONS

1. Wildlife habitat is better conserved by planning a few large subdivisions surrounded by extensive undeveloped land than by planning many small subdivisions surrounded by smaller areas of undeveloped land. The larger an area of undeveloped land, the greater the possibility that it will be utilized as sanctuary, feeding sites, or other basic requirements of the habitat for a variety of species.
2. Natural barriers such as steep slopes or rivers should remain intact in order to restrict access between housing developments and non-subdivided land.
3. Strips of dense cover within areas undergoing subdivision (i.e., coniferous forests, cattail-lined sloughs) should not be developed. Such areas provide travel lanes and escape routes for numerous wildlife species, thus allowing animals to move between developed and non-developed areas.
4. Laws should be enacted which penalize the owners of free-roaming dogs. Subdivision homeowners' associations often require that all buyers of such lots sign a set of protective covenants. Covenants making it illegal to allow one's dog to roam free are rarely enforced, however. Laws aimed at preventing the chasing, killing, or other harassment of wild animals should be rigorously enforced.

5. In reviewing subdivision plats according to the Montana Subdivision and Platting Act (Choate and Wertz 1947b) county commissioners should require changes in the platted housing density or in the location of subdivisions in order to lessen the impariment of important habitat areas.
6. Owners of rural homesites should be informed as to how they might enhance wildlife habitat within their property. Wildlife biologists or county extension agents, for example, might be given the job of informing rural residents about such things as ways to reduce dog and cat predation on wildlife, why not to handle baby animals, or landscape plantings for birds.
7. Owners of bona fide farmland should be strongly encouraged to place their property in "greenbelt status," as this would help prevent future increases in their property taxes caused by the residential development of other nearby properties. Market values of farmland in an area undergoing subdivision are often inflated beyond their worth as agricultural land. If these lands are also taxed at a value reflecting their potential non-agricultural usage, the eventual sale and subsequent subdivision of such lands is much more likely.
8. In addition to greenbelt, other means of preferential taxation such as conservation easements and the designation of "natural areas" should be utilized as methods for preventing the subdivision of important wildlife habitat.

9. Flood plain zoning should be enforced to prevent the subdevelopment of riparian forests, sloughs, marshes and other valley bottom areas.

CHAPTER VIII

SUMMARY

The objectives of this study were: (1) to determine the average loss of wildlife habitat in a clearly defined area that has both existing and proposed residential subdivisions within its boundaries, (2) to determine the alteration in the quality of the wildlife habitat when homes were built within such habitat, (3) to determine the changes in wildlife use of habitats adjacent to residential subdivisions as a result of the increased human and human-related activities in these areas, and (4) to suggest methods for lessening the detrimental impacts of rural subdivisions upon existing wildlife and wildlife habitats.

The study area was located in the Bitterroot Valley, 11 miles south of Missoula, Montana, in the vicinity of the town of Lolo. The study area was 10,189 acres in size and in 1973 contained approximately 2,000 residents. The 24 platted subdivisions within the study area amounted to 6.4 percent of the total acreage.

Non-field research methods included: preparation of ownership maps for pre-subdivision and current periods; preparation of a land use map for the pre-subdivision time period; identification of cover types on aerial photographs for pre-subdivision, during subdivision, and current periods; and measurement of cover types destroyed or altered by subdivision development. Ownership maps showed where subdivision and other residential development was occurring and the magnitude of such development in relation to the size of adjacent undeveloped areas. The pre-subdivision land use

map provided a reference source for the location and juxtaposition of wildlife habitats. Cover types destroyed or altered by subdivision development were measured in one of two ways: (1) where the former cover type within the boundaries of a subdivision was uniform, the total acreage for the subdivision equaled the number of acres of the cover type replaced, (2) where more than one cover type formerly occupied the site of a subdivision, a polar planimeter was used to measure acreage of each cover type replaced.

Field research methods consisted of both observations and interviews. Observations included: the locations of wildlife and wildlife habitat, the presence of dogs and other domestic animals in these areas, and human use of areas adjacent to the residential sites. Interviews were conducted with both study area residents and with professional wildlife biologists. Interviews yielded information concerning land use changes, changes in wildlife numbers and diversity, seasonal habitats of the various wildlife species, and past evidence of wildlife harassment.

The acreage representing ownership parcels less the 20 acres in size increased by approximately 1220 acres between 1937 and 1973. Field observations show that most parcels in this size category are used for either residential or commercial purposes.

Two hundred and sixty-five acres of agricultural land, 213 acres of rangeland, 102 acres of forest, 68 acres of wet area, and 7 acres of sandbar were the cover type acreages altered or destroyed by subdivisions. Three subdivisions were platted either partially or entirely on rangeland, ten on agricultural land, seven on riparian vegetation, and four on marshes, sloughs or wet meadows. Residential sites were disproportionately distributed with subdivision development being heaviest west of the

Bitterroot River. Only one subdivision was platted east of the river and parcel sizes on the east side were considerably larger than those immediately west of the river.

Wildlife diversity and, for many species, population sizes were already declining before the subdivision boom in the Lolo area in the mid-1960s. Two reasons for such declines were decreasing heterogeneity of agricultural land use and increasing recreational use of the Lolo and adjoining areas by non-Lolo residents. These and other factors complicated the task of judging only the effects of subdivisions upon wildlife and wildlife habitat.

Cover, to a greater extent than food or water, is the habitat requirement that has been the most jeopardized as a result of subdivision activity in the Lolo area. Subdevelopments tend to lessen the interspersion between cover types, break the continuity of dense cover areas utilized as travel corridors and escape routes, and reduce the total acreage of cover areas utilized as sanctuaries. When a subdivision breaks up the continuity of a cover type or substantially reduced its size, many species utilizing these areas suffered greater harassment by people and their pets. The larger an area of cover, the more frequently it was utilized by those species whose habitat requirements it satisfied. The most heavily used cover areas were those separated from residential areas by either distance or physical barriers. Where access to sanctuary areas was difficult, species numbers and diversity were higher than in those areas where access was less restricted.

The density of homesites largely determined the amounts of food, water, and cover remaining within residential developments. Housing density varied greatly among Lolo residential areas. In one low density residential area, wildlife habitat for ducks, great blue herons and white-tailed deer may have improved as a result of the cessation of intense agricultural land use.

Differential abilities to live in close proximity to rural residential areas were noted among the species studied. With the exception of medium-sized carnivores, the avian species displayed a greater ability to adapt to the habitat changes caused by residential land development. Coyotes, red foxes, striped skunks, crows, and black-billed magpies all remained at about the same numbers or increased during the period of subdivision development. White-tailed deer, beavers, muskrats, mallards, blue-winged teal, and cinnamon teal declined. The decline in the population of moose, Hungarian partridges and ring-necked pheasants was accelerated as a result of subdivision development. Elk usage of winter range areas adjacent to subdivision has declined but the causes of such a decline were felt to be factors exerted outside the study area.

The small group of elk still utilizing the rangelands adjacent to two subdivisions were more frequently observed during periods of winter stress caused by deep snow or extreme cold. Elk, coyotes and white-tailed deer utilized the strips of forested areas adjacent to residential subdivisions as travel corridors.

Incidents of dogs harassing wildlife were observed in Lolo prior to the recent period of rapid subdivision development. As the Lolo population has grown, however, so have the incidents of such harassment. The

wildlife species that are most often the prey of dogs in Lolo are white-tailed deer, and to a lesser extent ducks, pheasants, and muskrats. The continual presence of free-roaming dogs about residential areas may permanently displace portions of the local deer population from their home range.

Habitat deterioration in the Lolo area and the resultant decline in many wildlife populations will continue as the population grows. Unless subdivision development is abated the populations of white-tailed deer, beaver, muskrats, and wild ducks will continue to decline. Even the more tolerant species will begin to decline as Lolo becomes more urbanized and the remaining wildlife habitats deteriorate.

A long-term future study was proposed in which predevelopment baseline data is collected. Such a study should be limited to one or two species or to a group of related species such as birds. The dependency on field observations and interviews for the collection of wildlife data about subdivisions is subject to bias. Biotelemetric methods would help eliminate such biases.

Nine management suggestions were given for preserving wildlife habitats in areas subject to subdivision land development.

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APPENDICES

APPENDIX A—Acres of Subdivision by County[26]

County	Dept. of Revenue[27] March, 1973	EIC[28] Summer, 1974
Beaverhead	1,887	1,867
Big Horn	228	662
Broadwater	86	151
Carbon	2,325	2,621
Cascade	4,704	8,460
Custer	768	17,876
Deer Lodge	2,769	1,832
Fergus	1,142	1,460
Flathead	100,079	56,442
Gallatin	15,573	19,999
Glacier	1,909	635
Golden Valley	1,180	1,204
Granite	5,415	3,888
Jefferson	2,125	2,866
Judith Basin	193	1,460
Lake	19,977	9,880
Lewis and Clark	14,406	10,659
Lincoln	8,163	2,994
Madison	2,187	13,475
Meagher	870	1,402
Mineral	1,004	2,136
Missoula	33,800	40,816
Musselshell	-0-	33,031
Park	5,454	8,052
Pondera	776	558
Powell	12,205	6,928
Ravalli	19,239	50,267
Rosebud	342	454
Sanders	-0-	1,398
Silver Bow	-0-	2,129

Acres of Subdivision by County (continued)

County	Dept. of Revenue[27] March, 1973	EIC[28] Summer, 1974
Stillwater	6,029	8,713
Sweet Grass	380	703
Teton	651	353
Toole	702	2,081
Yellowstone	17,243	18,647
Total Acres Subdivided	283,811	336,099

Explanation:

The March, 1973, figures are based on suburban tract data gathered by the Montana Department of Revenue. This data is considered to give conservative estimates of the magnitude of subdivision development in Montana for the following reasons (Brandes 1974):

1. There is no definite definition of a suburban tract. The data gathered by county assessors are subject to time, effort and interest constraints, as well as differing interpretations of the term suburban tract.

2. Generally speaking, lots greater than five acres are not necessarily included as suburban tract by county appraisers and lots greater than 40 acres are seldom included.

3. Not all real estate transactions are recorded by the county clerk and recorder. There is currently no legal requirement to record a deed for those real estate transactions falling outside the scope of subdivision as defined by the Montana Subdivision and Platting Act. Also, contracts on a contract-for-deed basis, tend not to be recorded at the time of the sale.

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[26]This table and the following explanation were taken directly from Brandes (1974), pp. 11-12.

[27]From Montana Department of Revenue 1974, Twenty-sixth biennial report, Helena, 121 pp.

[28]From Environmental Information Center 1975.

Discrepancies between the Department of Revenue and the Environmental Information Center figures can be explained as follows (Brandes 1974):

1. The suburban tract classification also includes orchards. This may explain the substantially larger Department of Revenue figures in Flathead, Lake, and Lincoln Counties.

2. In Madison County, Shining Mountains has subdivided 10,784 acres; 5,320 were recorded after March, 1973.

3. In Custer County, Sundial Estates and Ranchettes encompasses 17,000 acres. The land had not been platted or filed; however, 40 acre tracts were being sold.

4. In Musselshell County, R.L.C. Inc. has subdivided 15,440 acres since March, 1973. Reforestation, Inc. has subdivided 10,306 acres; dates were not recorded. Timber Tracts, Inc. holds 3,940 acres.

APPENDIX B—Mammals and Birds Seen within the Study Area[29]

	Route(s)
Mammals:	
Black Bear (*Ursus americanus*)	2
Red Fox (*Vulpes vulpes*)	3,4,6
Coyote (*Canis latrans*)	1,5,6
Yellow-bellied Marmot (*Marmota flaviventris*)	4
Columbia Ground Squirrel (*Citellus columbianus*)	2,3,5,6
Yellow Pine Chipmunk (*Eutamius amoenus*)	2,5,6
Red Squirrel (*Tamiasciurus hudsonicus*)	3,5,6
Beaver (*Castor canadensis*)	3
Striped Skunk (*Mephitis mephitis*)	4,5
Muskrat (*Ondatra zibethicus*)	1,2,3,4
Porcupine (*Erethizon dorsatum*)	5
Mountain Cottontail (*Sylvilagus nuttallii*)	1,3
Elk (*Cervus elaphus*)	6
White-tailed Deer (*Odocoileus virginianus*)	1,2,3,4,5,6
Birds:	
Canada Goose (*Branta canadensis*)	1,2,3,4
Mallard (*Anas platyrhynchos*)	1,2,3,4
Pintail (*Anas acuta*)	1,2,4
Gadwall (*Anas streptera*)	2,3
American Widgeon (*Mereca americana*)	1,4
Blue-winged Teal (*Anas discors*)	2,3,4
Cinnamon Teal (*Anas cyanoptera*)	1,4
Wood Duck (*Aix sponsa*)	1,2
Bufflehead (*Bucephala albeola*)	3,4
Common Merganser (*Mergus merganser*)	1,3
Hooder Merganser (*Lophodytes cucullatus*)	1
Cooper's Hawk (*Accipiter cooperi*)	2
Marsh Hawk (*Circus cyaneus*)	2,3
Red-tailed Hawk (*Buteo jamaicensis*)	2,6
Bald Eagle (*Haliacetus leucocephalus*)	3,4
American Kestrel (*Falco sparverius*)	1,2,3,4,5,6
Ruffed Grouse (*Bonasa umbellus*)	2,4,5
Ring-necked Pheasant (*Phasianus colchicus*)	3
Hungarian Partridge (*Perdix perdix*)	5,6

[29] This list includes only those species actually seen along one of the six routes during one or more of the 115 observation periods. The sign of other species such as the raccoon (*Procyon lotor*) and northern pocket gopher (*Thomomys talpoides*) were observed but the animals themselves were not seen.

Mammals and Birds Seen within the Study Area (continued)

	Route(s)
Birds (continued):	
Great Blue Heron (Ardea herodias)	1,2,3,4
American Coot (Fulica americana)	1,3
Spotted Sandpiper (Actitis macularia)	4
Lesser Yellowlegs (Totamus flavipes)	4
Common Snipe (Capella gallinago)	2,3,4
California Gull (Larus californicus)	3
Mourning Dove (Zenaidura macroura)	1,2,3,4,5,6
Great Horned Owl (Bubo virginianus)	2
Common Nighthawk (Chordeiles minor)	5
Calliope Hummingbird (Stellula calliope)	3,5
Belted Kingfisher (Megaceryle alcyon)	1
Red-shafted Flicker (Colaptes cafer)	1,2,4,6
Lewis' Woodpecker (Asyndesmus lewis)	1,2,3,4
Yellow-bellied Sapsucker (Sphyrapicus varius)	3
Hairy Woodpecker (Dendrocopos villosus)	1,2,4,5,6
Downy Woodpecker (Dendrocopos pubescens)	1
Eastern Kingbird (Tyrannus tyrannus)	1,2,3,4,5,6
Western Empidonax Flycatchers (Empidonax spp.)	1,3,4
Violet Green Swallow (Tachycineta thalassina)	3,4
Tree Swallow (Iridoprocue bicolor)	3,4
Barn Swallow (Hirundo rustica)	4
Steller's Jay (Cyanocitta stelleri)	5,6
Blackbilled Magpie (Pica pica)	1,2,3,4,5,6
Clark's Nutcracker (Nucifraga columbiana)	6
Common Raven (Corvus corax)	6
Common Crow (Corvus brachyrhynchos)	2,3,4,5,6
Clack-capped Chickadee (Parus atricapillus)	2,5,6
Mountain Chickadee (Parus gambeli)	2,6
Red-breasted Nuthatch (Sitta canadensis)	1,5,6
Pygmy Nuthatch (Sitta pygmaea)	5
Robin (Turdus migratorius)	1,2,3,4,5,6
Western Bluebird (Sialia mexicana)	1,6
Starling (Sturnus vulgaris)	3,4,5
Yellow-rumped Warbler (Dendroica auduboni)	3,6
Yellow-throated Warbler (Dendroica dominica)	1
American Redstart (Setophaga ruticilla)	3
House Sparrow (Paser domesticus)	2,3,4,5
Western Meadowlark (Sturnella neglecta)	2,3,4,5,6
Red-winged Blackbird (Agelaius phoeniceus)	2,3,4
Brewer's Blackbird (Euphagus cyanocephalus)	5
Western Tanager (Piranga ludoviciana)	6
American Goldfinch (Spinus tristis)	1
Vesper Sparrow (Pooecetes gramineus)	1,2,3,4,5,6
Dark-eyed Junco (Junco oreganus)	5,6
Chipping Sparrow (Spizella passerina)	1,3,4,5
Song Sparrow (Melospiza melodica)	1,2,3,4